SURE FEED CROPS

JOHN FIELDS

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BY

JOHN FIELDS

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To the men, women, and children who are building and maintaining homes on the farms of the Central Southwest, and whose friendship and esteem are valued above all things else, this book is dedicated by

THE AUTHOR.

SURE FEED CROPS.

GENERAL STATEMENTS

1. Abundant and regular supplies of feed for livestock are vital to individual and collective agricultural prosperity. Livestock always have been the basis of every permanently profitable system of farming. Without the certainty of production of abundant feed crops, in unfavorable as well as in favorable years, the raising of livestock on the farm is as likely to result in loss as in profit through a series of years. If, at irregular periods, because of shortage of feed, it is necessary for farmers to dispose of their livestock, they must do so on a falling market at a great loss. Their investment in equipment for the care of livestock becomes unproductive and the entire system of farming becomes disarranged. When the time of plenty comes again, the building up of the breeding herds is a slow and expensive process. The supply is short and the demand is strong, making prices high.

2. Wide variations in climatic conditions in the United States call for greater differences in agricultural practice than have generally been recognized. The farmers from the Atlantic coast states who pushed into the unknown, set-

tling the Ohio valleys; the prairies of Indiana, Illinois, and Iowa; the valleys and plains of Kansas, Oklahoma, and Texas; brought with them their stores of practical experience in farming. Each at first followed the methods and tried to grow the crops to which he was accustomed. Many still do so. Capital for the development of new localities was required; it must be had from the old states, and the men who controlled it must be convinced that conditions are as they expected them to be. Scientific investigation of all matters pertaining to agriculture in the United States began along the eastern border; text and reference books relating to farming have largely been written from the standpoint of conditions which do not exist in Kansas, Oklahoma, and Texas. Every influence has tended to cause farmers in these states to follow the old methods and grow the old crops.

3. A system of farming, based upon experience and experiment in these states of the Central Southwest, where rainfall is always variable and often deficient, and where strong winds and high summer temperatures introduce conditions unknown to farmers of the Northern and Atlantic coast states, must be developed and adopted. With limitations and modifications which are indicated elsewhere in this volume, the general plan of operations should be the following:

Not less than ten acres of kafircorn or milo-

maize should be planted in April, May, or June every year on every farm. When drouth comes, they produce as much grain as corn averages in the best years; and the better the soil and the season, the higher the yield of these drouth-resisters.

Corn should be planted only on bottom lands.

Every acre of good, rich bottom land should be put to alfalfa as soon as possible.

The washy soils, hillsides, rough places, alkali lands, and low, overflow bottoms should be set to hardy bermuda grass, wherever this grass thrives.

The smooth, tillable uplands and prairies should be planted to kafircorn or milomaize for a sure crop of grain for feed and sale, to cowpeas and peanuts for feed and forage and soil improvement, and to oats, wheat, broom corn, and cotton for cash crops, wherever the soil and climate are suitable.

Those who follow such a system, stick to it, and feed most of what they produce to good livestock, will be the ultimate owners of the farms of the Central Southwest.

4. Production must replace speculation before farming will be on a safe business basis. For a period in the eighties and early nineties in Kansas, and until very recently in Oklahoma and Texas, the get-rich-quick idea seemed to dominate everything. The influence of the towns, where nearly everything centered around schemes to sell lots for greater and still greater

prices, extended to the farms. The purpose of those who farmed seemed to be to get the land into such shape and crops as would make it sell readily to someone else whose purpose was not to make it his home, but to sell at a higher figure to still others with the same idea. Permanent agricultural prosperity cannot come until attention is turned from speculation to production. Whatever has been unfavorable in the past has been largly the fault of men who have hoped for a change in climatic conditions to suit their desires and who have failed to appreciate the fact that regular and certain production of crops, every year, is the only foundation for permanent land values.

5. Rainfall does not increase and the climate does not change as the result of the occupation of any region by men. "The So-Called Change of Climatic Conditions in the Semiarid West" is fully discussed in an article by Richard H. Sullivan, Local Forecaster, Weather Bureau, Wichita, Kansas, in the 1908 Yearbook of the U. S. Department of Agriculture. He states: "It is the man that has changed, not the climate, and the face of nature has changed with efforts far exceeding those of the early eastern pioneers. The western man who has observed the wilderness blossom as the rose decries his own power when he charges to the account of change of climate the blessings resulting from his own initiative. It required much more than the buzzing of the drones while the climate was

'changing' to make orchards, meadows, grain fields, and vineyards in Oklahoma, Kansas, Colorado, Nebraska, and the Dakotas." And again: "We are led to the conclusion that the so-called changes in climate have been nothing more than irregular oscillations; that a succession of dry years has given way to recurring wet years; that there are alternating series of warm and cool years; that drouths are possible in any part of the country at any time, winter or summer."

6. "Scientific agriculture" has in recent years come to be an expression with which to conjure and to obtain increased appropriations and additional jobs for friends of the administration, both national and state. "Scientists" who know but little of science have developed "systems" which they insist will grow corn, whether it rains or not. Those with lands for sale in regions of limited and variable rainfall have lured the hopeful settler on and, in countless cases, left him stranded. The mysterious hocus-pocus which is supposed to make the impossible happen with regularity has been invoked in all of its forms. But it is coming now to be understood that the problem of profitable farming in the Central Southwest has been solved by many farmers. It may be solved by all who will grow those crops and follow the methods which experience has demonstrated may be depended upon to produce an abundance of feed for livestock, no matter how unfavorable

the season. There is no better statement of the situation than that made by the late Dr. S. A. Knapp, who said: "Agriculture is not a science and it has but little science in it. That little science can be taught. The remainder must be acquired by observation, experience, and business methods. Agriculture might be defined as being about one-eighth science, three-eighths art, and half business."

THE GRAIN

KAFIRCORN

7. Partial failures of Indian corn when the prairies of Kansas were being developed into farms brought heavy losses to many of the early settlers. In 1876, kafircorn was brought from South Africa, but it was not generally cultivated until 1890. The Kansas Experiment Station, from 1889 to 1900, investigated cultural methods and the feeding value of kafircorn. The Oklahoma Experiment Station, beginning in 1892, followed similar lines of study. The conclusions were widely published, but they were not generally adopted and put in practice by farmers. Public sentiment opposed the admission that it was necessary to grow this drouth-resisting crop. Farmers who persisted in doing so were called "kafircorn woolies" and urged to grow a "dignified crop," such as Indian corn.

8. Kafircorn made slow progress as an important crop. Butler county, Kansas, led in the production of kafircorn in 1911. In 1897, the farmers of this Kansas county planted 187,873 acres to Indian corn and it brought a return of $2.30 per acre. They had begun learning a

little of kafircorn and had 11,714 acres of it planted that year; it turned off $9.75 per acre. But the habit of planting large acreages of Indian corn is firmly fixed. In 1910, thirteen years later, these farmers had abandoned only one-third of the acreage of the crop which had brought in $2.30 per acre and had replaced it with the crop which cashed in for $9.75 per acre. In 1910, Butler county, Kansas, had 139,924 acres planted to corn; it yielded $6.60 per acre. And the 58,789 acres planted to kafircorn turned in $13.00 per acre.

9. The supreme test of kafircorn came in the season of 1911. Speaking of it, J. B. Adams of El Dorado, Kansas, who has had much to do with establishing kafircorn as a real crop in Butler county, said: "It was a season of unusual severity, the dryest and hottest in Kansas as it was in Oklahoma since 1901. A pitiless sun burned up the Indian corn and parched the native grass upon the prairies. Throughout this trying ordeal, our unfailing friend, the hardy and indomitable kafir, stood sentinel upon the prairies with that patient fortitude inherent in its nature, born of centuries of hardship upon the desert; it bided its time and silently waited for rain, springing triumphantly into new life with the first downpour from the heavens. Our prairie hay turned out less than a third of a crop and our alfalfa only a little better than half a crop. But notwithstanding this accumulation of calamities, we pushed back the im-

pudent face of famine, cheated the hot winds, and whipped the drouth to a standstill, with kafircorn." Referring to the influence of kafircorn upon the fortunes of his community, Mr. Adams said: "In 1896, half of the upland portion of our county was owned by eastern investors, fire insurance and loan companies, the titles having been secured by that peculiar investment process known as mortgage foreclosures. Uplands that had formerly been considered worth from $15 to $25 per acre were offered without buyers at from $3 to $8 per acre. These lands, now selling at from $30 to $50 per acre, have been bought back by our farmers and most of them paid for with kafircorn."

10. The cash returns from kafircorn and corn through a series of years show kafircorn's true place among the crops grown upon the farms of the Central Southwest.

The Kansas State Board of Agriculture issues annual reports based upon assessors' returns showing the acreage and value of every crop grown. The following statement of the cash value of kafircorn and corn for the past eleven years was compiled from these published reports. A careful study of it is commended to those who repeat the statement that Indian corn yields more than kafircorn, and who in other ways display their entire lack of knowledge of what they are talking about.

	Value per acre.	
	Kafircorn	Corn
1901	$ 10.32	$ 3.23
1902	12.69	11.20
1903	9.30	8.74
1904	9.72	7.81
1905	9.94	10.11
1906	9.18	9.89
1907	11.13	9.25
1908	10.88	11.70
1909	11.23	10.77
1910	12.92	8.89
1911	15.72	7.68
Total, 11 years	$123.03	$99.27
Average	$ 11.18	$ 9.02

In Kansas, the average cash return from an acre of kafircorn during the past eleven years was 23.94 percent. greater than from an acre of corn. The figures are based on the total acreage planted to these crops during that period.

Corn turned off more money than kafircorn in but three years out of the eleven, and in each case the difference per acre was less than a dollar.

In 1901, the value of kafircorn per acre was more than three times the value of corn. In 1911, an acre of kafircorn brought more than twice as much money as an acre of corn.

It is not likely that the best land was planted

to kafircorn, or that it had as good cultivation as corn.

11. Many landowners positively prohibit the planting of kafircorn on their land. Others encourage it. One farm loan company, which has been in business in Kansas since 1881, and in Oklahoma since 1889, has adopted the following plan: "We have for three years been refusing to lease land under our charge to a tenant who will not put at least one-half of the land, intended for corn, to kafircorn, the blackhull white variety being preferred. On one farm in Kay county, Central Oklahoma, the tenant had in 1911, 120 acres of Indian corn which made thirty bushels to the acre. On this same farm were 100 acres of kafircorn which made sixty bushels per acre. The land is of the same quality. The old idea that kafircorn ruins the land is passing away. If kafircorn is planted reasonably early, the grain harvested and the stalks plowed under while green, the land will be enriched. We write it in the lease that the tenants shall plant as much kafircorn as they plant of Indian corn."

12. Growing a crop of kafircorn is not difficult. In general, the same methods of preparing the soil, planting, and cultivating as are used in growing Indian corn should be followed. Kafircorn will produce a crop on any soil which will grow anything else; the better the soil, the higher the yields. Hard land should be plowed

during the fall and winter and worked down to a firm seed bed. Flat planting gives better results than listing on such soils. Very sandy soils should not be plowed. The lister should be used in the same manner as for planting corn on such lands, but shallower.

13. Blackhull white kafircorn is the standard variety. It has yielded more than others in practically all comparative tests. Seed of this variety has been selected and improved by the Kansas and Oklahoma Experiment Stations and by growers so that it is now possible to obtain first class seed for planting. Different varieties of kafircorn cross-pollenize just as do different varieties of corn. It is an advantage if all farmers in a given locality grow the same variety. The grade of the product to be marketed is lowered by a mixture of varieties, which always bring lower prices than the pure article. A germination test of kafircorn seed should always be made before planting. When stored in bulk, it heats readily. This injures the seed so that much of it may not germinate. Kafircorn seed which has a musty odor or which sticks togther in lumps should not be used for planting.

14. A warm soil is needed for the germination of kafircorn seed. It should not be planted until after the usual time of planting Indian corn. In Oklahoma, the highest average yields have been secured from plantings made from April 15th to

May 15th, though much kafircorn is planted as late as June. In regions where cotton is grown, kafircorn may be planted just before planting the cotton. Not less than four months from planting time until frost is desirable for the maturing of kafircorn. Five months is better, because in very dry weather, kafircorn waits and makes practically no progress toward maturity.

15. The distance between plants has an important bearing upon the yields of kafircorn. The rows should be not less than three and one-half feet apart. Where the average annual rainfall exceeds forty inches, single plants should be about four inches apart. The distance between plants should gradually be increased as the average annual rainfall diminishes until they are a foot apart in regions with less than twenty-five inches of rain. Planters should be adjusted so that single grains are dropped at the proper distances. The tendency is to plant kafircorn too thickly, probably because most planters are equipped with "cane" plates. Blank plates should be obtained and drilled especially for kafircorn. From two to five pounds of kafircorn seed will plant an acre, varying with the distance apart at which the grains are dropped.

16. The cultivation of kafircorn should be the same as that given Indian corn. Because of the fact that kafircorn withstands drouth, many

fail to give it the care and cultivation which it must have to produce maximum yields. The plant is smaller and weaker than Indian corn when it first comes up. The first cultivations may be given with the harrow, followed by whatever implements are available. Late cultivation should be shallow so as not to disturb the extensive root system of the kafircorn, which fills the soil more completely than the root system of Indian corn. The harrow cultivator with fourteen teeth, or a mower wheel dragged between the rows will do satisfactory work. No crust should be permitted to form on the surface of the soil until after the grain is practically mature.

17. The harvesting of kafircorn presents some difficulties to those unaccustomed to the crop. With experience, these are quickly overcome and, with proper equipment, the work of harvesting kafircorn can be done more quickly and cheaply than can the husking of Indian corn. The stalk and leaves of kafircorn remain green long after the grain is mature, and usually until cut or killed by frost. The general custom in Butler county, Kansas, is to wait until the kafircorn has had a light frost. It is then cut with a corn binder and shocked. After curing in the shock for several weeks, the bundles are headed by a knife attached to a wagon box, (19) and the fodder is reshocked. The heads are stacked like headed wheat, a layer of hay or straw being first placed on the ground to protect them.

The threshing is done at convenient times during the winter.

18. In the Texas Panhandle, with its dry climate, the following method, described by a Swisher county farmer, is in general use: "When the grain is to be threshed, either for the market or to be ground and fed, we use an ordinary grain header of any of the standard makes. We allow the grain to mature thoroughly and prefer, if possible, to have one or two good frosts before cutting. Handled in this way, the grain should not be put in too large ricks on account of danger of heating. With one man to run the header, two men to run the header wagons, and one or two extra men to help unload, from twenty-five to thirty-five acres per day can be harvested. This method puts the heads in the ricks ready to be threshed at one handling." There is also a kafircorn header which is bolted to the side of a wagon box and does good work where the heads are produced at a uniform height.

19. Bound kafircorn can be headed more cheaply than corn can be husked. A farmer in Custer county, Western Oklahoma, gives the following description of his plan: "I use a knife made out of an old sixteen-inch plow lay. The landside piece should be taken off and the lay sharpened and straightened. Then have a hole drilled in the point, about an inch from the end. Bolt a piece of pipe five or six feet long

to the side of the lay for a handle. Get a flat piece of iron a little longer than the lay. Have holes drilled in each end. Bore two holes through the sideboard of the wagon box to match this iron, about an inch from the top. Put the knife in the inside of the wagon box, then the front end of the piece of iron, and bolt it. Put a couple of washers between the iron and the wagon box at the back end and bolt it. Keep the knife sharp with a file. If possible, put your box on a wagon with low wheels and put on double sideboards. One man can cut off the heads as fast as two can place them under the knife. The bundles can then be reshocked very quickly."

20. Heading kafircorn by hand is entirely practicable where only limited acreages are grown. A well balanced butcher knife or a very short bladed cane knife should be used and the heads should be cut off with as short a shank as possible, so as to hasten curing. Some leave the heads in small piles in the field for a few days before stacking; others place the heads in long ricks, eight to ten feet wide, direct from the wagons after first putting down a layer of stalks to keep the heads from the ground. Covers should be provided for use in case rain should come before the stack is completed and to protect the finished stack. If these are not at hand, the stack of kafircorn heads should be topped out with some material which will turn water. Kafircorn heads may also be stored in

roofed cribs, such as are used for storing Indian corn.

21. Kafircorn is threshed with the regular machines used for threshing wheat and oats. Small threshers with gasoline engine on the same truck are coming into general use in Western Oklahoma and are especially adapted to rough localities with poor roads. For use on the farm, it is not necessary in most cases that all of a crop of kafircorn be threshed. It is customary for the producer to do the threshing and it is well to delay this work until winter, when it may be done more cheaply, and the threshed grain will not heat so readily when stored. Ventilation from the bottom should always be provided in bins where threshed kafircorn is to be stored. Make one ventilator for each four feet of length of bin, extending across the bin and through the wall on each side, and raised about one inch from the floor. Two pieces of one by four lumber, spaced six inches apart with blocks of wood and covered on the two open sides with galvanized screen wire and open to the outside air at the ends, make good ventilators.

22. Concerning markets for kafircorn, H. M. Cottrell, Agricultural Commissioner of the Rock Island Lines, after extended inquiry among the largest buyers of grain in Chicago, made the following statement: "Kafircorn and milomaize are worth ninety percent. as much as the same

weight of corn for feeding work horses, beef and dairy cattle, hogs and sheep. The limited supply on the markets and the strong demand for these grains for poultry feeds has kept the price at or above that of corn. This has made it impossible for stockmen to buy these grains for the regular feeding and fattening of live-stock. A number of grain men have been consulted and every man stated that whenever the supply of kafircorn and milomaize became so large that it assumed an important place in the markets, it would be absorbed just the same as corn, oats, barley, and other feeds, selling at a price compared with the price for other grains proportionate to its feed value." To reach the markets, enough must be grown close to a shipping point to make it to someone's interest to buy and ship. There may have been no cash markets for single loads of kafircorn. But a thousand or ten thousand loads will find a ready market. no matter what the size of the corn crop. Kafircorn is usually quoted on the markets by the hundred weight instead of the bushel of fifty-six pounds. From seventy-five to eighty pounds of kafircorn heads, if well cured, will thresh out fifty-six pounds of grain.

23. Methods of feeding kafircorn differ but little from the best methods of feeding Indian corn. Kafircorn must be ground to obtain its full feeding value. In digestion experiments conducted by the writer at the Oklahoma Experiment Station in 1897-'98, two-thirds of the

weight of whole kafircorn fed to steers was recovered from the dung, practically unaffected by the digestive juices. It is true that hogs following steers fed whole kafircorn will put most of it to good use, but steers being fattened should be at more profitable work than predigesting kafircorn for hogs. Coarsely ground kafircorn contains 5.79 percent. digestible protein and 56.54 percent. digestible carbohydrates and fat. Average corn meal contains 6.13 percent. digestible protein and 74.36 percent. digestible carbohydrates and fat. Average analyses of kafircorn show that it contains a total of 11.2 percent. protein and 3.1 percent. fat; Indian corn contains a total of 10.4 percent. protein and 5.0 percent. fat.

24. For horses, kafircorn heads may entirely take the place of corn. The heads may be fed without grinding, but the feed is improved by running the heads through feed cutters which will cut them into quarter to half-inch pieces. The ration is improved by the addition of a limited amount of bran, shorts, or cottonseed meal, but this is not necessary if the horses have alfalfa, cowpea, or peanut hay. (81) It is desirable, however, when prairie hay is fed.

25. As feed for calves, kafircorn meal fed dry has been shown by the Kansas Experiment Station to be well suited to feed with skimmilk. Kafircorn meal has a tendency to constipate

animals to which it is fed and this overcomes the scouring effect of the skimmilk.

26. For fattening steers, ground kafircorn may entirely take the place of Indian corn. Excellent results have been obtained when ground kafircorn was fed with enough alfalfa hay or cottonseed meal to balance the ration. The results are not as satisfactory when ground kafircorn is fed alone and kafir or corn stover, prairie or sorghum hay, is used for rough feed. Comparisons of corn meal and kafircorn meal made at the Kansas Experiment Station, where some alfalfa hay was fed, showed ground kafircorn to be worth only 7 percent. less than ground corn for fattening steers. Beginning in 1899, the Oklahoma Experiment Station made a series of feeding experiments to ascertain the comparative value of corn meal, kafir meal, alfalfa hay, and kafir stover as beef producers. The trials were repeated three times. In the last year of the experiment, corn meal and alfalfa hay produced an average daily gain per steer of 2.39 pounds. Each pound of gain required seven pounds of corn and six pounds of alfalfa hay. The steers fed ground kafircorn and alfalfa hay made a daily gain of 2.36 pounds each and each pound of gain required seven and one-third pounds of grain and six and one-half pounds of alfalfa hay.

27. Fed to dairy cows, kafircorn should always be ground and it is especially important

that something be fed to balance the ration and overcome the constipating tendency of the kafircorn. Alfalfa, cowpea, or peanut hay is excellent for this purpose and when they are on hand, no feed need be purchased. If ordinary roughness is fed, the grain ration should consist of two-thirds ground kafircorn and one-third bran or shorts; or three-fourths ground kafircorn and one-fourth cottonseed meal. It is wasteful to feed unground kafircorn to cattle of any sort, and especially to dairy cows. The grain need not be threshed before grinding. Ordinary sweep mills, with proper attachments, will grind kafircorn heads just as they grind corn. Ground kafircorn heads are entirely satisfactory for all classes of cattle, but the ration should always be balanced with alfalfa, cowpea, or peanut hay, or cottonseed meal.

28. Growing pigs should be fed alfalfa, cowpea, or peanut hay, or shorts in addition to kafircorn heads, or ground kafircorn, which should be moistened before feeding. Kafircorn heads should be fed on a slightly sloping floor so that the refuse will be worked to one side. As an exclusive ration, kafircorn will not take the place of corn in pig feeding. Kafircorn contains less oil than corn, and pigs fed exclusively on ground kafircorn quickly become constipated and get out of condition. This trouble may be entirely avoided by balancing the ration with home-grown feeds which are rich in protein. (150, 172, 184.)

29. For fattening hogs, ground kafircorn or ground kafircorn heads may practically take the place of corn, though the addition of something to balance the ration is desirable and profitable. There is nothing better than alfalfa, cowpea, or peanut hay for this purpose. There is less waste if the hay is cut into short lengths before feeding, but the cheapest gains will come from feeding the hay in low racks where the hogs can get at it without wasting it. At the Oklahoma Experiment Station, one lot of 115 pound shoats was fed what cowpea hay the pigs would eat in addition to a mixture of one-half kafircorn meal and one-half corn meal. They consumed four and three-fourths pounds of grain for each pound of gain. Another lot fed the same kind of grain but no cowpea hay consumed eight and one-fifth pounds of grain for each pound of gain. The lot receiving cowpea hay had better appetites, ate more grain, and made much better gains than the lot which did not receive cowpea hay.

If none of these hays is to be had, cottonseed meal, if judiciously fed, may profitably be used. Five pounds per day of ground kafircorn heads with one-half to one pound of cottonseed meal will make a good ration for a hundred-pound hog. In a trial at the Oklahoma Experiment Station, pigs fed a ration of four-fifths ground kafircorn and one-fifth cottonseed meal made a daily gain of 1.28 lbs. each, using 3.19 lbs. of grain costing 1.72 cents to produce a pound of

gain. At the same time, other pigs fed a ration of one-half ground kafircorn and one-half corn meal made a daily gain of 1.04 lbs. each, using 5.71 lbs. of grain costing 2.55 cents for each pound of gain. (84.)

30. As poultry feed, no single grain is superior to kafircorn. It need not be ground, except for chicks. It does not tend to fatten hens rapidly as corn does and consequently is a better egg-producer. Much of the kafircorn which is marketed is used in the preparation of poultry feed and its use for this purpose is rapidly increasing.

31. Kafircorn makes good silage. O. E. Reed of the dairy department of the Kansas Agricultural College says: "For silage, kafircorn is better than cane but not as good as corn. Kafircorn ranks between the two in food value, acreage yield, and effect on the soil. Its special advantages over corn are that it is more drouth-resisting and yields higher. It generally yields about seven tons to the acre." Other points in kafircorn's favor are: it is practically certain to produce a crop of grain and forage, corn may not do so in very dry seasons; the plant remains green long after the grain is mature, thus giving a longer time during which the silo may be filled; the corn plant dies quickly after the ear is formed; kafircorn is more conveniently handled by corn binders and ensilage cutters.

32. Kafircorn smut sometimes reduces the

yields. It is different from corn smut and may be prevented by treating the seed with a solution composed of one pound of formaldehyde to thirty gallons of water. With this strength of solution, the seed should be soaked for one hour and then dried. It takes about four and one-half gallons of this solution to treat one bushel of seed and the treatment costs about five cents per bushel. At the Kansas Experiment Station, untreated seed produced about thirty percent. of smutted heads while treated seed produced no smut whatever.

33. Kafircorn blight is popularly supposed to be caused by rain washing the pollen from the heads while in bloom. The Bureau of Plant Industry, U. S. Department of Agriculture, has recently reported the results of investigation of grain-sorghum production in the San Antonio region of Texas. The results indicate that the blasting of heads of kafircorn is due to the work of the sorghum midge instead of to rains while the plants are in bloom. The experiments also showed that when kafircorn is planted early, it has a much better chance of escaping this trouble than if planted late. Relatively little loss has been caused by blight of kafircorn, especially where it is treated as a real crop instead of an afterthought.

34. Kafircorn seed may be selected and improved more easily than can seed corn. The entire plant, including the head, may be taken

into account when selecting kafircorn seed. Plump, well-filled heads, borne by sturdy stalks of uniform height should be selected after the crop is fully matured. These should be hung up in a dry and well-ventilated place and the grain should be left on the heads until just before planting time. Tall stalks which appear in the field should be removed before they bloom. These show a mixture with broom corn, sorghum, milo, and other related varieties and are even more undesirable than a mixture of grains of different colors in Indian corn. The Oklahoma Experiment Station, by continued selection, developed a strain of blackhull white kafircorn having much larger grain than the kind usually grown, and still retaining all of the other desirable characters of the crop. Many farmers have also, by continued selection, worked similar improvements in the kafircorn which they grow.

35. "Kafircorn ruins the land" is probably the most frequently offered excuse for not growing kafircorn. Many farmers who carefully located their feed lots and barns near the head of a draw, so that a heavy rain will haul out the manure, say that they will not plant kafircorn "because it will ruin the land." When urged to plant kafircorn, they seem suddenly to become much concerned about maintaining the fertility of their soils. Recent analyses published by the Oklahoma Experiment Station show that a crop of thirty bushels of kafircorn removes from the

soil 32.9 lbs. nitrogen, 6.5 lbs. potash, and 10.4 lbs. phosphoric acid; a crop of thirty bushels of corn removes 30.7 lbs. nitrogen, 6.8 lbs. potash, and 11.0 lbs. phosphoric acid. The differences are so slight that they amount to nothing. But since in 1911, kafircorn on the farm of the Oklahoma Experiment Station yielded fifty-six bushels per acre while Indian corn alongside yielded nothing, there is no question in this instance about kafircorn removing more of the elements of plant-food than Indian corn did.

36. Kafircorn dries out the soil because of its extensive root system and the fact that it continues growing until killed by frost. Corn dies while kafircorn still finds enough moisture in the soil to keep it in good condition for growth when rains come. Corn is dead in August or September and quits taking moisture from the soil. Kafircorn keeps on growing until killed by a freeze and usually leaves the soil very dry in November. Land which grew kafircorn, unless it is sandy, should all be plowed before Christmas. The effect of the thorough drying of the soil can be overcome by turning the land over and giving the frosts of winter a chance to break it up so that it may absorb and hold the rain which falls. Many farmers in Butler county, Kansas, insist that kafircorn actually improves the soil. There are fields on which kafircorn has followed kafircorn for fifteen years without any reduction of yield. But on this land, the kafircorn is headed high and the fodder

is turned under early in the winter. The decayed vegetable matter has improved the physical condition of the soil so that the removal of the plant food by the successive crops of grain has not yet been noticed on the yields. Kafircorn should be rotated with other crops, such as oats, cowpeas, peanuts, and cotton. With proper attention given to early and thorough preparation of land which has grown a crop of kafircorn, its fancied ill effects upon the soil fertility will disappear.

37. Actual experience in the growing of any crop under the varying conditions of farm practice finally determines its place in a system of farming. Kafircorn is actually being grown, marketed, and fed with profit by many thousands of farmers in the Central Southwest. Brief statements from a few of them, relating their experiences in 1911, follow:

38. Washita County, Western Oklahoma. "I have been planting kafircorn for three years and expect to continue planting it and to increase the acreage each year. I have my barn full of kafircorn heads now and it looks good to me."

"I have lived here eleven years and have tried all of this time to grow Indian corn. Made two good crops of corn, three short crops, from ten to twenty bushels per acre, mostly trash and smut, and six complete failures. In all of these eleven years, I have never seen a failure of

kafircorn. It has always produced a crop, wherever it had any show at all, and I have never seen any kind of a crop respond more readily to good land and good cultivation than kafircorn does."

39. Custer County, Western Oklahoma. "I have been in the state only since December 1, 1909, and got my lesson with Indian corn the first year. If it had not been for about twenty acres of kafircorn which I planted that year, I could not have pulled through. One acre of my kafircorn made more than all my crop of corn. In 1911, I had fifty-seven acres of kafircorn and milomaize and, regardless of the extreme drouth and torrid winds, it made good yields. I am billed for kafircorn, milomaize, cowpeas, and alfalfa and, unless my wife does the planting, we will not have a patch of roasting ears. The old-timers here call me a 'kafircorn wooly' and I am proud of the name."

40. Kiowa County, Western Oklahoma. "I planted some kafircorn in April and May, 1911. In July, after it began raining, I planted two hundred acres more to kafircorn and milomaize. It made so much feed that I had to come to the Oklahoma City stockyards to buy steers to eat it. They weighed 700 lbs. and cost me $4.48 in October. They were fed this kafir and milo with just enough alfalfa and cottonseed cake to provide lubrication. On March 19, 1912, they weighed 1060 lbs. at the Oklahoma City stock-

yards and sold for $6.25, topping the market for that weight. I'll have to grow kafircorn for a few years before I can afford to make any more attempts to prove that I live in a 'great corn country'. After this, my corn acreage will be limited to a roasting ear patch."

"In 1911 from fifty-five acres of sod kafircorn, I raised 1590 bushels of threshed grain. All the attention this had was to break the sod about three inches deep in March, and in April to plant three and one-half bushels of kafircorn with an ordinary two-horse planter. It was cut in September with a corn binder. The total expense of planting, cutting, and shocking was $104.50. Figure the crop of 1590 bushels at sixty cents, $954. Deducting $75 for threshing and $104.50 for other expenses leaves a net return of $774.50 and enough roughness out of the stalks to last a natural lifetime."

41. Woods County, Western Oklahoma. "I have finally got around to the conclusion that kafircorn is the only grain for this part of Oklahoma. As long as I remain sane and live here, I shall waste but little time on corn. It is hard to give up, but these hot winds are too much for it. Even moisture and the best of cultivation are no guarantee of a crop of corn."

42. Dewey County, Western Oklahoma. "I had fifteen acres of kafircorn in 1911 which made twenty-five bushels per acre. Thirty acres of corn in the same field made about six bushels

per acre. I shall put out another fifteen acre 'accident insurance policy' of kafircorn each year hereafter."

43. Texas County, Western Oklahoma. "To satisfy my curiosity, I measured out one bushel of kafircorn and kept it before my chickens until consumed. During the period, exactly one week, twenty-three laying hens laid eighty-one eggs, worth eighty-one cents on the market. That looks good, considering that the top price paid for kafircorn here this year has been sixty-two cents. But there were also twenty-eight early hatched pullets that helped consume the kafircorn. Most of them had recently been bought and were not used to grain except what they rustled from a milomaize field. The pullets must have also added considerable weight to their poor frames; at any rate, they consumed much of the grain."

44. Woodward County, Western Oklahoma. "I have raised kafircorn for eleven years and have always found a market for all I had to spare. Kafircorn surely gave this country a lift in 1911. There was a large acreage, on account of the failure of wheat, and the yields were from thirty to fifty bushels per acre. I raised about 1600 bushels."

45. Kay County, Central Oklahoma. "You advised planting ten acres of kafircorn. Why did you not say one hundred? Kafircorn has never failed since I have been here. An aver-

age acre of kafircorn will make more beef or pork in Oklahoma than an average acre of corn will in the north. And it will make five to ten times as many eggs."

46. Pawnee County, Central Oklahoma. "Where kafircorn and milomaize were planted at the right time in 1911, they made good yields. My own made from sixty to seventy-five bushels per acre. Corn in the same field did not make over two bushels per acre."

47. Lincoln County, Central Oklahoma. "I plant plenty of other stuff for feed so that I will not need the kafircorn stalks. As soon as the heads are ripe, I cut them off with a tree pruner. As soon as I am through heading, I plow the green stalks under good and deep. I first tried this on a five-acre piece which I considered the poorest spot on the farm, but it made forty bushels of Indian corn to the acre the next year. If it had not been for kafircorn in 1911, I would have been compelled to dispose of all my pure-bred Berkshire hogs, but I have been able to keep the best of them."

48. Kingfisher County, Central Oklahoma. "I have been in Oklahoma three years; came from Canada. I have been trying to raise corn but have not been very successful. I had one hundred and thirty acres the first year and it averaged about four bushels; the next year fifty acres which averaged about eight bushels; sixty

acres in 1911 and it made a total crop of about sixty bushels. I have three hundred acres for crops in 1912, and will have one hundred and forty acres of wheat, twenty-five of oats, ten of cotton, fifteen of corn, and the rest in kafircorn. There will not be much corn for me after this."

49. Osage County, Central Oklahoma. "When the dry weather came on in 1911, we saw that we were going to lose the corn crop. I relisted the ground and planted one hundred and fifty acres to kafircorn. This made an average of forty bushels per acre and was sold for fifty cents a bushel. You can see that hereafter, kafircorn will always be good enough for me."

50. Murray County, Eastern Oklahoma. "We never had much experience with kafircorn or milomaize until in 1911 when we got all kinds of experience. Much of the corn and stubble land was planted at different dates, ranging from May 20 to August 20. Kafircorn planted in May yielded about twenty bushels per acre. Milomaize didn't yield as much grain as kafircorn and made much less fodder. Corn was a complete failure."

51. Johnston County, Eastern Oklahoma. "Last spring I asked you about planting kafircorn and milomaize and you gave me what I've found to be facts. I told you then that I intended to plant thirty acres of kafircorn and am

kicking myself for not doing it. I planted only twelve acres and it made good."

52. LeFlore County, Eastern Oklahoma. "I planted five acres of kafircorn on oats stubble and it was fine; thin land too. I got more from it than from three crops of oats."

MILOMAIZE

53. The value of milomaize and its final place among the crops grown in regions of limited and variable rainfall have not been determined as fully as for kafircorn. The crop is of more recent introduction, having first been grown in the United States about 1885. Many farmers in the Central Southwest got their first experience with both kafircorn and milomaize in the very dry season of 1911. After all else had failed, these crops were planted in July and early August. It is but natural that many should use the comparative returns from these crops, planted late and under unfavorable conditions, as a basis for determining which crop to plant on at least a portion of the land usually planted to corn. Because late planted milomaize generally matured more grain than kafircorn planted on the same dates, many jumped to the conclusion that milomaize is a more satisfactory crop than kafircorn.

54. Both crops have their place and the writer has given much attention to determining the

conditions under which one is to be preferred to the other. For fifteen years, and especially throughout the season of 1911, information bearing upon this has been gathered by correspondence and personal investigation. In the fall of 1911, the entire matter was gone over with W. D. Bentley, G. L. Bishop, and F. F. Ferguson, agents of the farmers' co-operative demonstration work of the U. S. Department of Agriculture, who travel constantly over Oklahoma, inspecting the work of county agents and visiting farmers who are striving to improve their methods.

55. **The grain crop** to replace all or a portion of the corn, if it is to attain much importance, must be planted at about the same time that corn is usually planted. There is an interval of about a month between the time corn and cotton are planted, approximately April 15 to May 15 in Oklahoma. Planted between these dates, kafircorn is more resistant to drouth than milomaize. In 1911, early planted kafircorn generally matured a good crop while much of the milomaize planted at the same time died. Many instances were reported where milomaize heads had blasted in the boot, like corn tassels, while kafircorn merely stopped growing and waited for rain.

56. **Harvesting with machinery** is necessary in order that any grain crop may become of commercial importance. Kafircorn may be

harvested with machinery in common use, such as wheat binders, headers and header binders, wagon box kafircorn headers, and corn harvesters. Milomaize, even under the best conditions, is not easily harvested by machinery and if planted early, is usually very difficult to gather. A close examination of fields of these two crops will make this difference very clear. Very few men would choose the job of harvesting one hundred acres of milomaize instead of a like acreage of kafircorn. And these few wouldn't do it again.

57. Milomaize matures grain in a shorter time than is required by kafircorn. This characteristic makes it more desirable than kafircorn for regions with high altitude and short growing seasons. Where the average annual rainfall is less than twenty-five inches, milomaize is preferred as a grain crop. In those localities, the crop is usually planted in June. If planted earlier, milomaize will furnish early grain feed for hogging down. Where the average annual rainfall is between twenty-five and forty inches, milomaize may be planted on wheat or oats stubble immediately after harvest. Kafircorn resists the work of chinch bugs better than milomaize and if the bugs are present in the stubble, the former is safer, even for late planting.

58. Dwarf yellow milomaize is the variety most generally grown. It generally yields fully

as much and is harvested more easily than the standard yellow variety. Careful selection of seed is required to maintain the dwarf habit. The number of stalks bearing the head erect instead of on a crooked shank may also be increased by planting seed from erect heads or by close planting. A white variety of milomaize is also grown to a limited extent but its value in comparison with the yellow variety has not been determined. A farmer in Beckham county, Western Oklahoma, reported: "I had two plats planted to white milomaize last year and they made forty-one bushels per acre. Some kafircorn and yellow milomaize were also raised and they made good yields. The men who raised them have plenty of feed and are selling it to those who raise cotton and plant corn."

59. **A uniform product** is more desirable if the grain is to be put on the market. If different farmers on the same day offer to the buyer one load of blackhull white kafircorn, one load of red kafircorn, one load of yellow milomaize, one load of white milomaize, one load of "fodderinktum," one load of "buncoita," and several loads of miscellaneous mixtures and crosses of these with each other and with broom corn and different varieties of sweet sorghum, the market is apt to go off. This can be shipped only as mixed stuff, no grade, and will bring low prices in comparison with what would have been obtained if full cars of either blackhull

white kafircorn, or of yellow milomaize had been shipped.

60. Methods of growing milomaize differ but little from those used in growing kafircorn. (12-16) Thorough and early preparation of the soil and killing the weeds before planting pays well. If the crop is to be planted after wheat or oats are harvested, the stubble should be disked as the crop is cut. As soon as possible, milomaize should be planted in shallow lister furrows at about the same distance between plants as for kafircorn. (15) Frequent, shallow cultivations should be given until the crop is well along toward maturity.

61. When a corn crop fails completely, as it did over much of Oklahoma in 1911, milomaize may yet produce good yields of grain. A farmer in Tulsa county, Eastern Oklahoma, reported: "I have a good bottom farm; raised from fifty to sixty-five bushels of corn to the acre with the exception of 1901 and 1911. I made twenty-five bushels per acre in 1901 and the hot winds cooked one hundred and twenty acres for me in 1911. I cut the corn off of forty acres and disked the land good. On July 19, I began planting milomaize. It came up and grew fine; cultivated it three times. When the seed began hardening, we cut and shocked twenty acres; we headed the other twenty acres and it made better than fifty bushels per acre. The eighty acres of corn left made from

three to twenty bushels per acre on better land." But July cannot always be depended upon to have sufficient rainfall to make this practicable every season.

62. Harvesting milomaize is usually done by cutting the heads off by hand. The irregular height of the stalks and their tendency to sprawl around, and the crooked stem on which the head is borne, make heading by machinery difficult. But milomaize may be headed as cheaply as corn can be husked. Since the fodder of milomaize is of but little value, heading is usually put off until after frost. The heads are thus fully matured and cure out readily, though it is well to take the same precautions as with kafircorn to prevent heating. (20-21.)

63. Markets for milomaize are becoming established, the same as for kafircorn. But the best market for both of these crops is livestock to consume them on the farm which produced them. Milomaize may be threshed with the usual machinery and the methods are in general the same as for kafircorn. (21.)

64. For feeding, milomaize has about the same value as kafircorn. It has not been studied so fully by the experiment staions but there is a large accumulation of the results of practical experience. Average analyses show that milomaize contains 10.7 percent. protein and 2.8 percent. fat. (23) The grains being larger

than kafircorn, grinding is not so essential and this is one of the chief points of preference by those farmers who grow milomaize instead of kafircorn for feed for their own stock. While desirable, it is not so necessary that a ration of milomaize be balanced with other feeds, as is the case with kafircorn. (24-30) A Tulsa county, Eastern Oklahoma, farmer summed up his experience briefly: "Milomaize is as good feed as corn to feed whole to horses and nearly as good as corn for hogs. For poultry it is the best feed that grows, but for cattle, it should be cracked."

65. "**Horses doing heavy work** should be given three feeds of milomaize a day," says H. M. Cottrell, Agricultural Commissioner, Rock Island Lines. "It is usually fed in the head, one-half more heads being given than would be fed of ears of corn. Most teamsters prefer to feed milomaize in the head, cutting the stem off close. The main stem of the head and the many little stems with the seed attached force the horse to do a large amount of chewing before the grain can be swallowed, and this mastication grinds the grain and mixes it with the saliva, increasing the proportion digested. Ground milomaize makes a good horse feed. Horses and mules have stood well hard work all summer, such as breaking prairie, with no grain but milomaize."

66. **Laxative feeds**, rich in protein, such as

skimmilk, alfalfa, cowpeas, and peanut hays and cottonseed meal, add to the returns obtained from feeding milomaize, either whole or ground. Ground milomaize is excellent for feeding to skimmilk calves, the starch of the milomaize replacing in feeding value the fat removed from the whole milk by skimming. It is not necessary to grind milomaize to be fed to hogs. For cattle, the grain may be fed in the head but returns will be better if the heads or the threshed grain are ground.

67. Experience of growers and feeders of milomaize on the farms of the Central Southwest is a reliable guide for others not accustomed to growing the crop. Conditions vary widely and general conclusions strictly applicable to one locality may not entirely apply to others. For that reason, the location of the farmers making the report is given in what follows:

68. Kiowa County, Western Oklahoma. "You requested us to report on the relative drouth-resistance of milomaize and kafircorn. I find that the latter stood the drouth of 1911 best. When the rains came on the fifth of July, the kafircorn was still standing and waiting to produce a good crop while milomaize seemed too old to head well. These were planted the last days in April."

69. Major County, Western Oklahoma. "In

1912, I shall plant at least one hundred acres of kafircorn but no milomaize. I had both in 1911, but the milomaize isn't in it at all. I found that it was extra good for chinch bugs, while they didn't harm the kafircorn."

70. Lincoln County, Central Oklahoma. "In July, 1911, I planted all of my oats stubble and other idle land to milomaize. It all matured and made a good crop. If all farmers had done the same, there would have been enough feed for all of Oklahoma without shipping any in from other states."

71. Beaver County, Western Oklahoma. "I have grown kafircorn from the time it was first known until I came here. It takes from one hundred and twenty to one hundred and fifty days for kafircorn to mature and only eighty-five days for milomaize. Kafircorn should be planted between the times for planting corn and cotton, but milomaize should be planted later. To prepare the land for milomaize, I do nothing until the last probable snow of the season; then I disk down the stubble and when we get a rain, list. After that, I disk and use the knife sled until the last of June. Then I list and plant. I cut milomaize with a row binder in October, just before frost, and the stock eat all of it. I regard this plan with milomaize preferable to any plan with kafircorn west of the hundredth meridian. My method of handling the land is to keep all the snow, kill all the weeds, always

keep a good, deep mulch on the land (four inches is not too deep), and I do not plant until the soil gets warm, which at our elevation is the middle of June.

72. Caddo County, Central Oklahoma. "In 1911, we had four plots of milomaize and kafircorn. The first was plowed in April and flat planted in May; then the weather turned so dry that neither came up until June. One-half of the field was milomaize and the other half kafircorn; both had the same cultivation, plowed four times and one hoeing. Milomaize grew very high and lodged in spots. Kafircorn stood up well and stood the drouth better; made forty bushels per acre; clay soil. The second was all kafircorn; some of the land plowed early and the rest late in May. Weeds were two feet high and ground very dry when plowed. Early plowing made forty bushels per acre; late plowing thirty-five bushels; sandy soil. The third was one-half milomaize and the other half kafircorn; listed in June; weeds were full grown; used log chain on lister to cover them. This was plowed six times. Milomaize made fifty bushels per acre; kafircorn thirty bushels; both stood up well, no difference in drouth-resistance. Land was dark sandy. Milo grew very short, not near as tall as flat planted. The fourth field was plowed in May, weeds two feet high and ground very dry. Flat planted milomaize the latter part of May. Plowed four times,

made fifty bushels of heads per acre. It grew very tall but didn't lodge until late in the fall. This was sub-irrigated land on which corn in the same field with the same attention made only ten bushels per acre. Our experience in feeding is that the stover of kafircorn far exceeds that of milomaize in value; but for grain, milomaize is the best. Hogs will not eat kafircorn when they can get milomaize, but poultry like kafircorn best. Both should be ground but not fed alone for best results; they should be balanced with other feeds."

73. New varieties of non-saccharine sorghums are constantly being brought out by those who wish to make money out of the general disposition of mankind to think that the fishing's better in the next hole. The value of kafircorn and milomaize has been determined by experiments and experience. Properly grown and fed, they are known to be profitable crops and much more certain than Indian corn to produce good yields under trying conditions. The farmer who is struggling against odds to establish a farmstead will do well to let the U. S. Department of Agriculture and the experiment stations do the experimenting. Public funds are appropriated for this purpose and all must pay a portion of the expense. Years of careful work are required to determine the probable commercial value of any crop and the individual farmer who constantly follows after the "new

and wonderful'' rarely arrives at a condition of prosperity. Only one of these new varieties which have recently been exploited will be mentioned:

74. "Desert wheat," sometimes called "Egyptian wheat," "Mexican wheat," or "wheat corn," is one of the "three much misrepresented sorghums" about which the U. S. Department of Agriculture has issued a Farmers' Bulletin. Of it, Professor A. M. Ten Eyck of Kansas said: "The tests of this crop at this station indicate that it is not so valuable as sorghum or kafircorn either for fodder or for grain. The yields of the grain have been less than the yields of kafircorn, and the crop is objectionable because the stems are usually very slender and the crop lodges badly and is hard to harvest. In my judgment, seedsmen are selling it at a high price simply because it is a novelty, or not well known."

COTTONSEED PRODUCTS

75. Cottonseed is a sure feed crop not fully appreciated in any of the states which grow cotton. Oklahoma alone, in 1911, produced more than 500,000 tons of cottonseed. But because of the tendency of the cotton crop to dominate and almost to drive out other lines of agriculture, resulting in very limited numbers of livestock on farms which grow cotton,

most of this valuable feedstuff, in the form of cottonseed meal and cottonseed cake, was shipped to northern, eastern, and European feeders. This great economic waste is caused by the failure of cotton growers of the southwestern states to grow the sure feed crops with which to make a properly balanced ration of cottonseed meal and thus obtain and retain the full value of the grain crop produced along with the lint of cotton.

76. Cottonseed should be sold to the cotton oil mills and cottonseed meal should be bought back from the mills and fed, whenever prices bear their proper relation to actual feed values. Cottonseed oil has a much higher commercial value than feeding value and is present in excessive amounts in cottonseed. The exchange value of cottonseed for cottonseed meal and the relative economy of feeding one or the other depends upon the kind of animal to be fed and the rough feed which is available. Approximately, a ton of cottonseed has the same feeding value as twelve hundred and fifty pounds of cottonseed meal, but the actual returns obtained from feeding a ton of cottonseed may fall far below those secured from feeding twelve hundred and fifty pounds of cottonseed meal, properly balanced with kafircorn, milomaize, or corn.

77. A ton of cottonseed produces about 300 pounds of oil, 800 pounds hulls, 750 pounds cot-

tonseed meal, 30 pounds linters, and 120 pounds waste and trash. The fertilizer constituents of a ton of cottonseed are 63 pounds nitrogen, 23 pounds potash, and 25 pounds phosphoric acid, worth not less than $12.85 if bought in the form of commercial fertilizers. Cottonseed contains 12.5 percent. digestible protein and 17.3 percent. digestible fat, and the difficulty in feeding cottonseed lies in properly balancing this excessive amount of fat.

78. Cottonseed meal contains 37.6 percent. digestible protein and 9.6 percent. digestible fat. The fertilizer constituents of a ton of cottonseed meal are 113 pounds nitrogen, 36 pounds potash, and 54 pounds phosphoric acid, costing at least $21.45 if bought in the form of commercial fertilizers.

79. Cottonseed hulls are produced in slightly larger amount than cottonseed meal by the oil mills. Cottonseed hulls contains 0.3 percent. digestible protein and 1.7 percent. digestible fat; for comparison, corn stover (fodder with the ears removed) contains 1.4 percent. digestible protein and 0.7 percent. digestible fat. The fertilizer constituents of a ton of cottonseed hulls are 13.4 pounds nitrogen, 20.8 pounds potash, and 8.6 pounds phosphoric acid, costing $3.38 if bought as commercial fertilizer. The most extended use to which cottonseed hulls have been put is as roughage for short-fed

steers receiving cottonseed hulls and cottonseed meal as practically their sole ration.

80. Cottonseed may be fed profitably to stock cattle being wintered on rough feed, the amounts being limited to about two pounds per day per head. This is about the only purpose for which it is advisable to feed cottonseed in preference to cottonseed meal or cake, and if the roughage contains considerable grain, such as kafircorn or milomaize, the feeding of small amounts of meal or cake is likely to be more generally satisfactory. Cottonseed should never be fed to hogs. They may eat some of it and get away with it if they have free range and plenty of green feed, but some of them are very likely to die. The feeding of any considerable amount of cottonseed to cows makes the butter hard and tallowy, and it is practically impossible to compound a properly balanced ration using any considerable amount of cottonseed.

81. For horses, cottonseed meal combined with three to five times as much kafircorn, milomaize, or corn is an improvement over any of these grains fed alone. But cottonseed meal should not be fed to horses in larger amounts than this and should never be fed as the sole ration of any animal. A few experiment stations have used cottonseed meal as a part of the feed for work horses and the results have been generally satisfactory. Horses do not seem

to like cottonseed meal, and the amount fed per day should in no case be more than two pounds.

82. For dairy cows, cottonseed meal is generally a very economical feedstuff. It should never be fed alone. Three parts of ground kafircorn, milomaize, or corn, mixed with one part of cottonseed meal, at the usual prices, makes a cheaper, and always a more effective ration than any of these grains fed separately. The excess of protein of the cottonseed meal is balanced by the excess of starchy materials of the kafircorn, milomaize, or corn and both classes of food materials are more fully utilized by the cows. The ration should gradually be increased to the amount which the different cows will put to good use in the increased production of milk. The certainty of production of kafircorn, milomaize, and cottonseed meal in seasons of extreme drouth, and their high feeding value, make them of great value in maintaining the stability of the dairy industry in regions of variable rainfall. (27) Fed as suggested, there is absolutely no danger to the health of cows receiving cottonseed meal. Instead, their condition and production will steadily improve because of their needs being supplied with properly balanced food nutrients.

83. For fattening steers, cottonseed meal is very satisfactory as a part of the ration. Numerous feeding experiments have established

its value and determined the general manner in which it should be used. Where the rough feed consists of kafir, milo, or corn fodder, sorghum or prairie hay, the grain ration should consist of two parts ground kafir, milo, or corn to one part of cottonseed meal. If alfalfa or cowpea hay constitutes a portion of the rough feed, the proportion of cottonseed meal in the grain ration may be reduced to one-fourth or one-fifth for the most of the feeding period, and increased to one-third toward the close. If kafir or milo fodder or silage containing considerable grain is fed, cottonseed cake may be fed, gradually increasing the amount to four pounds per day per head. The fact always to be kept in mind is that in feeding cottonseed meal or cake to cattle of any class, they should receive kafircorn, milomaize, or corn to balance the ration. Where rough feed is abundant and contains some grain, cottonseed meal or cake may be fed without admixture with other grain, but slower gains will be obtained. Unless the roughage supplies grain, cottonseed meal should not comprise more than one-third of the total grain ration.

84. Hogs may follow cattle being fed cottonseed meal and will make profitable gains, especially if there are hogs enough to clean up the droppings completely and to require a little ground kafircorn, milomaize, or corn in addition. This is the most satisfactory manner

in which to feed cottonseed meal to hogs and losses are very rare when this is the practice. Cottonseed meal will not do at all as an exclusive grain ration for hogs, but it may be fed with profit in amounts of from one-tenth to one-fifth of the total grain ration of fattening hogs. Long continued feeding of larger amounts of cottonseed meal to hogs frequently results in losses and when there are the first symptoms of trouble, it is well to drop the cottonseed meal out of the ration for a week or two. Many feeders sour the ration containing cottonseed meal by soaking in water; others find that hogs receiving wheat or rye pasture while on a ration containing cottonseed meal are rarely troubled from its effects. The feeder who will use cottonseed meal judiciously in fattening hogs will find it very profitable. The careless feeder, who will not go to the trouble of taking the simple precautions necessary, is very likely to suffer losses. A feeder in Washita county, Western Oklahoma, reported: "I have never soaked nor soured a pound of cottonseed meal before feeding to hogs. I have fed cottonseed meal to as high as one-fifth of the grain ration, usually from a sixth to a tenth, for the last six years and I have never lost a hog. In the spring of 1912, for a tail-end bunch I fed them for ninety days on one-fifth cottonseed meal and ground kafircorn. They had the run of a small wheat pasture. Another man in Washita county fed out two car loads in 1910, and a finer and better

finished bunch of hogs I never saw. He fed them soaked corn and one-fifth cottonseed meal. He soaked his corn separately and then put it in the trough and poured the cottonseed meal over it. The hogs were all alfalfa-grown hogs. He fed them sixty days and they gained two pounds a day. Another Washita county feeder in 1911 fed seven tons of cottonseed meal to three cars of hogs at a ratio of about one to four with corn. He fed seven hundred and fifty dollars worth of feed and sold nineteen hundred dollars worth of hogs. This man was induced to try the meal after reading of the man who fed the two carloads the year before. But before he would risk the bunch, he visited the other feeder and then went home and penned up a few of the stringiest old sows he had to make a test for himself. They made such fine gains in so short a time without loss that he laid in a supply of cottonseed meal and went after the rest of his herd in earnest." (29.)

85. As feed for calves, neither cottonseed nor cottonseed meal is satisfactory. They do not have the proper composition to replace the fat of milk removed by skimming. Ground kafir-corn, milomaize, or corn is entirely satisfactory for this purpose. (25.)

86. All of the cottonseed meal produced in the states of the southwest should be fed here. The plant food alone which it contains is worth almost as much as it sells for. It contains the

nitrogenous material necessary to balance the excess of starch contained in kafircorn and milomaize and its oil overcomes the slightly constipating tendency of these feeds. The greatest profit from these crops is obtained by feeding them to livestock in the communities which produce them, thereby obtaining the higher prices for the finished product, and retaining the elements of plant food to maintain the fertility of the soil for the production of future crops. But an abundance of cottonseed meal cannot be utilized in the absence of production of kafircorn and milomaize, in years when corn is a failure. And the fact that cottonseed meal is one of the surest of feed crops is the reason for including it in this discussion. It is a foolish waste for the farmers of the south to continue shipping their fertility to Europe, receiving in return scarcely more than they pay for plant food bought as commercial fertilizers. But they can escape from this waste only by the production of other sure feed crops which will place the livestock industry on a foundation from which it cannot be dislodged by a season of short rainfall and excessive temperatures.

THE FORAGE

ALFALFA

87. Alfalfa fully compensates for the uncertainty of the corn crop in regions having a variable annual rainfall averaging from twenty-five to thirty-five inches. Within this belt in Kansas, Nebraska, and Oklahoma, a larger proportion of the total area than of any other part of the earth's surface of equal size is producing alfalfa profitably. Texas contains a vast, undeveloped region of a similar character which ultimately, there is every reason for believing, will grow alfalfa fully as well. With the full utilization of suitable soils in the production of alfalfa, and appreciation of the certainty with which kafircorn, milomaize, and cotton produce grain for raising and fattening all classes of livestock, the people of this region, who once resented its being designated "semi-arid," will be proud to proclaim it as such.

88. Alfalfa is invulnerable, almost, to damage from long-continued drouth when once firmly established. In Oklahoma, the seasons of 1909 and 1910 were below the average in amount and seasonable distribution of rainfall. The year

following, 1911, surpassed all previous records for unfavorable conditions. In September of that year nearly all of the alfalfa fields in some counties looked brown and almost bare of vegetation, and many feared that the alfalfa had died. In April, 1912, after sufficient rains to soak the soil and penetrate the subsoil to a depth of perhaps five feet, not a single field of alfalfa which was examined along fifty miles of road, in a county where drouth had been most severe, appeared noticeably damaged. Where it had not been pastured, the alfalfa was then standing from six to ten inches high. During the years of drouth, it had produced more net returns than any other crop. And when the rains came, without expenditure of money, time or effort, save perhaps to loosen the sun-baked soil, alfalfa was ready to produce a crop in May worth more money than the net returns from other crops after an entire season's labors. The marvelous ability to withstand extremes of drouth and heat which alfalfa has shown, when once established, furnishes the strongest of reasons for extending the acreage until it occupies all suitable soils within this region where soil and climate are so favorable for its growth.

89. Not all soils will grow alfalfa profitably under ordinary conditions of preparation of the soil and care of the stand of alfalfa when once secured. The most favorable soils are the fertile, alluvial, and comparatively level lands

bordering the streams, above the overflow and commonly called "second bottom land." The best of these are those with a close surface soil changing rapidly to a moderately open subsoil into which the tap roots of alfalfa may easily penetrate. When the subsoil is not of very tough clay, with rock close to the surface, the surface soil may even be quite sandy and, aside from increased difficulty in obtaining a stand which may be overcome by proper methods which are discussed later, (98) be entirely satisfactory for maximum alfalfa production. The character of the soil rather than its location with reference to streams determines its natural adaptability to this crop and many wide areas of such soil exist far removed from streams.

90. Fertility of the soil is important in establishing alfalfa. It is established with difficulty, for example, on soils which have been cropped to wheat successively for many years until deficient in available plant food, and especially in available nitrogen. Sandy soils on which have been grown clean culture crops, without returning vegetable matter to the soil, until most of the humus has disappeared are not in condition for seeding to alfalfa. The "hard lands" which have been farmed for several years without manuring until they have become sticky and pasty, forming thick crusts after rains and great cracks after drouths, are not easily transformed into profitable alfalfa fields.

While perhaps less than one-twentieth of the total area of the states of the Central Southwest is land on which alfalfa may profitably be grown on a large scale, on fully nine-tenths of the farms is some land which, if given proper preparation, will produce alfalfa at a profit for the livestock of the farm.

91. A deep seed bed, but firm right up to the surface; enough moisture in the soil to germinate the seed and establish the plants without rain; and good seed, free from weed seed and sure to grow, are essential to obtaining a stand of alfalfa. These conditions may be obtained in various ways but are the fundamentals which should always be kept in mind. Young alfalfa plants are exceedingly tender and often must combat conditions over which the farmer has no control. This makes it all the more important that close attention be given to those factors which can be controlled.

92. Stubble lands, from which a crop of wheat or oats have been harvested in June, may be put into excellent shape for sowing to alfalfa between August 15th and September 20th, if there is sufficient rainfall during that period. Such land should be thoroughly disked just after the grain is cut, the disk harrow following the binder around the field. This saves the moisture in the soil and breaks down the stubble so that the soil turned over will pack readily and make good connection with the bottom

of the furrow. Plowing should be done as soon as possible. The depth of plowing should depend on the previous depth to which the land has been plowed. It is not desirable to turn up more than an inch of the subsoil, but plowing to a depth of less than six to eight inches is poor preparation. Each half-day's plowing should be gone over at once with a sub-surface packer, or a heavily weighted disk harrow set nearly straight, going along with the furrows. Enough harrowings should be given to keep down the weeds and grass and to prevent the formation of a crust, but not enough to reduce the surface soil to a powder which will blow easily.

93. **Do not disk** land to be sown to alfalfa at any time after it has been plowed and packed. If harrowing has been neglected until a sod of grass and weeds, or a hard crust, has formed, the damage cannot be repaired by disking and loosening the surface to a depth of three to five inches. Perhaps this is the mistake most commonly made by those who have had no experience with alfalfa. They have a notion that a "deep, mellow seed bed" will be made by the disk harrow and that alfalfa sown in such a seed bed will start right off and grow. But when sown after a disking, the alfalfa seed is placed in a bed of dust or in soil full of air spaces which dries out quickly, and unless rain

sufficient to firm the soil about the alfalfa seed falls very soon after sowing, failure results.

94. If land for corn was plowed deep, and the corn was given clean cultivation which left it level, and the crop is matured, cut as low as possible, and removed from the land before September 1st, good stands of alfalfa may be obtained from sowing into the corn stalks. Disking the stalks, unless heavy rains follow, is likely to loosen the soil to too great a depth. The stalks should be dragged down, using a weighted section harrow thrown down flat; this may not be necessary if the stubs are very short. Harrowing enough to smooth out inequalities in the soil may sometimes be desirable but care should be taken not to destroy the good seed bed which the cultivation of the corn crop has prepared. (91) Exceptionally favorable conditions and careful work are requisites for success in fall seeding of alfalfa after corn.

95. Fall seeding of alfalfa is more generally successful than spring seeding east of the thirty-five inch rainfall line, and is generally preferred by alfalfa growers. In all cases, conditions at the time when the sowing should be done must determine whether to sow or to save the seed and wait until spring. Unless the seed bed is well settled and filled with moisture, so that the sowing may be completed not less than thirty days before the average date of the first

killing frost, it is safer to wait. The work of preparation will not be lost; usually such land is in the best of condition for early spring seeding, if not spoiled by disking or plowing again.

96. Preparation for spring seeding should begin at least a year before the time alfalfa is to be sown. Weeds and grass should be killed out by growing crops which assist in their eradication. If the land is to be planted to corn, cotton, or other clean culture crops, it should first be plowed deep and the work of the cultivator should be supplemented with the hoe and no weed seed should be permitted to mature. If wheat or oats are to be followed the next spring with alfalfa, a crop of cowpeas (169, 170) grown on the stubble and pastured off or plowed under will add to the fertility of the surface soil and greatly improve the chances of success. The plowing should be completed in all cases before the last of December. If the soil is of the kind which drifts with the winds, it may be well to leave it rough. Methods must be modified to suit soil conditions, but harrowing and firming of the soil should be done so as to put the land in condition before March 1st for seeding when weather conditions become suitable.

97. The time of spring seeding cannot be fixed by dates on the calendar. Just when to sow must be determined by the temperature of the soil and weather conditions. The earlier alfalfa is sown after danger of hard freezes is

past, the better the chances for success. Alfalfa sown in March, if it escapes a freeze, will withstand drouth much better than later sowings. This was well illustrated in the very unfavorable season of 1911 when practically the only spring-sown alfalfa which came through with a good stand was that sown in March. Alfalfa sown in April has an unequal struggle with the winds and weeds of spring, and if sown in May, there is danger of damage from the dashing rains. The later the sowing in the spring, the more trouble there will be with weeds and grass.

98. Sandy lands comprise approximately one-third of the area of Oklahoma. Not all are so sandy that they blow, but there are wide areas where it is very difficult to hold the soil in place until crops are established. Methods of getting alfalfa established on such soils are very different from those necessary to success on hard lands. With soils only moderately sandy, and in regions where there is usually moisture enough for fall seeding, plowing may be done in June or July and the soil should be worked down as firmly as possible. The danger of loss then comes from the fall and winter winds. Some have overcome the blowing by scattering rotten straw with a manure spreader, just thickly enough to stop the sweep of the winds but not enough to smother the plants. It may be necessary to press the straw into the soil by running a disk harrow, set straight, over it.

Others have sown a small amount of sorghum, kafircorn, or broom corn seed, or spring oats with alfalfa in the fall. These come up, make some growth in the fall, but are killed by frost. The dead plants remain through the winter and into spring, and protect the alfalfa plants from the wind.

99. New land, if the soil is sandy, is better for alfalfa than soil which has been farmed without manuring until most of its vegetable matter has disappeared. The sod, when chopped up with a disk harrow, will hold the sand together until the alfalfa covers it.

100. Decayed vegetable matter, incorporated with sandy soils, will help hold them in place until alfalfa may be established. Some have successfully followed the plan of sowing sorghum on sandy soil in the spring and plowing it under just before it heads. This decays quickly and is followed with spring oats sown early in September. This when frozen down protects the surface of the soil and prevents drifting. In March, alfalfa is sown into the dead oats with a disk drill, disturbing the soil cover as little as possible. These are a few of the ways which have been tried with varying results on very sandy lands. It taxes the patience and ingenuity of the man who is farming sandy land when he sets about getting a stand of alfalfa. When once established, the crop, however, is worth all of the perseverance

necessary to obtain it. Where the sandy land is reasonably level, with water ten to twenty feet from the surface, permanent success with alfalfa when once established is certain.

101. The amount of seed usually sown is twenty pounds per acre. If conditions for sowing are ideal and the alfalfa seed is perfect, ten pounds to the acre is enough. That amount of seed, if all of it grows, will make more plants than there is room for. But it is rare that everything is just right and fifteen pounds to the acre is as little as it is advisable to sow under average conditions. It is a waste of seed to sow more than twenty pounds. The best seed for sowing in the states of the Central Southwest is that produced as near as possible to the place where it is to be sown. Seed produced on irrigated land is not satisfactory.

102. Alfalfa seed should be tested for germination and examined for weed seed before purchasing, if possible, and certainly before sowing. The Experiment Stations, at Manhattan, Kansas; Stillwater, Oklahoma; Fayetteville, Arkansas; and College Station, Texas, make these tests, usually without charge. An ounce of the seed should be sent at least two weeks before a report is needed. Neglect of this precaution may result in getting a troublesome start of dodder and other pests along with the alfalfa.

103. "Alfalfa will not grow here" is an expression frequently heard by way of apology for wasting fine alfalfa lands in growing wheat or cotton, or trying to grow corn on them. A township in southern Oklahoma, along the Red River, furnishes one example. It is a beautiful country, comparatively level, with excellent roads and a sandy loam soil with a comparatively open subsoil. Many farmers reported that alfalfa "does no good" there; that it had been tried and died out. This is an old story and has been repeatedly disproven after the men who farm the land have learned how to grow alfalfa. Farther west in Oklahoma, other communities along the same river, with exactly similar conditions, though not quite so favorable, have found alfalfa the most profitable crop which they can grow.

104. Thickening a thin stand of alfalfa is not always easily done, and it is practically impossible after the stand is more than a year old. If a satisfactory stand is not obtained from spring seeding, it may be thickened by harrowing or drilling in five to ten pounds of seed per acre in September, and again early the following March if the fall seeding failed to take hold. In the same manner, an unsatisfactory stand of alfalfa from fall seeding may be thickened by sowing more seed early in March, giving a light harrowing to cover. After alfalfa is more than a year old, it is better to plow up a poor stand

and start over again, than to attempt to thicken it by sowing seed.

105. Sowing alfalfa seed should be carefully done. Drilling, with implements which may be properly adjusted, permits the seed to be placed at a definite depth in moist soil and completely covered. This is especially important with sandy soils. With firmer soils, broadcasting is satisfactory. The soil should never be disked just before sowing. Instead, if the soil is full of moisture and a crust is just beginning to form on the surface, it should be harrowed before broadcasting only enough to make distinct harrow marks and slightly break the crust. Then a good cross harrowing after sowing will place most of the seed in moist soil and cover it to the proper depth. Alfalfa should not be covered to a depth of more than an inch to an inch and a half in such soils. If that depth of covering will not put the seed in moist soil, conditions are not right for sowing. In sandy soils, the seed may be placed as deep as two to three inches.

106. The care of young alfalfa is of vital importance in establishing a stand. Weeds and grass often interfere and, at times, choke out the alfalfa before it becomes established. In the absence of weeds, spring sown alfalfa should not be clipped until it begins blooming or the leaves begin turning yellow and dropping off. The cutterbar of the mower should be set high.

If young alfalfa is clipped short in hot weather, much of it may die before the buds have pushed out new leaves. But if it is not cut when blooming begins or the leaves begin dropping, the plants rapidly lose vitality. The treatment of weedy alfalfa must vary with the kind of weather and the kinds of weeds. Enough cuttings should be made to keep the young alfalfa from being shaded out, but they should be made at such times as are most likely to weaken the weed growth. This may sometimes be done when the weeds are in bloom. Crabgrass makes the most trouble with alfalfa sown in the spring and frequent mowings are necessary to give the young alfalfa a chance at the sunlight. Alfalfa sown in the fall, if a stand is obtained, is usually not much damaged by grass and weeds unless the land is very foul. It pay always to kill out weeds and grass before sowing alfalfa, rather than to attempt it afterwards.

107. For hay, alfalfa should always be cut when about one-tenth of the plants have come into bloom, or the lower leaves begin turning yellow and dropping off, or new growth begins from the buds at the base of the stems. Cut at this stage, the largest yield of digestible food materials will be obtained and the largest total crop through the season will be secured. When alfalfa comes into full bloom before cutting, many leaves are lost and the leaves are the most valuable part of the crop. The stems also be-

come woody and less of them are eaten; new growth also starts more slowly from stems which have partially matured. Many stands of young alfalfa are weakened by "waiting for it to get big enough to cut", after it has begun blooming.

108. Methods of curing alfalfa hay must, of necessity, vary greatly, depending upon the amount of growth, moisture in the soil and air, wind and sunshine. All steps taken should be directed toward saving the greatest possible amount of leaves. This can be accomplished by keeping the plants alive and transpiring moisture through the leaves for the longest possible time after cutting. Allowing to wilt in the swath and to cure in windrows, formed preferably with a side-delivery rake, seems to be the best general plan. West of the line of thirty inches average annual rainfall, weather conditions are often such that the problem is to get the alfalfa raked and stacked before it has dried out too thoroughly. It should not be put up as long as juice may be squeezed from a twisted bunch of stems. But it should not be permitted to lie in the swath until most of the leaves rattle off as it is raked. Every cutting of a crop of alfalfa requires the good judgment of the man in charge, working for the proper condition of the product instead of blindly following any set of rules. The fullest possible use should be made of machinery in handling

alfalfa, especially where there is any considerable acreage of it. Sheds for storing the hay, and stack covers, quickly pay back their cost in preventing damage from rains.

109. Cultivation of alfalfa needs to be done with judgment and must vary greatly with the character of the soil and the extent to which the alfalfa has been pastured. The over-enthusiastic use of the disk harrow, while seeming to give temporary benefit, has weakened many good stands of alfalfa. An ordinary smoothing harrow, weighted and set so that it will take hold, may be used with profit before growth starts in the spring on practically all alfalfa over one year old. And it can scarcely be used so as to do harm. If the soil is crusted or weeds and grass are starting at any time immediately after a crop has been cut, another harrowing will pay in nearly all cases. Where firm soils have been compacted by pasturing, judicious use of the disk harrow just as growth is starting in the spring is generally advisable. It will loosen the soil, save moisture, and admit air to the soil without which alfalfa cannot attain proper development. Spike-toothed disk harrows and special alfalfa cultivators with very narrow shovels are used by many with success and are especially useful in digging out crabgrass. All cultivation of alfalfa should be directed toward eliminating useless and harmful plants without doing damage to the crowns and roots of the al-

falfa plants. If the spike-toothed disk harrow is run at too great an angle, the crowns may be caught between the teeth of the disk and pulled up. If run with less angle and more weight or more times over, they do good work.

110. Webworms often destroy one or more cuttings of alfalfa during a season. Various spraying methods have been proposed and tried but the most practicable plan for fighting this pest seems to consist in cutting the crop as soon as they begin damaging it, and thus taking their food away from them. This should be done no matter at what stage of growth the alfalfa may be, because if left undisturbed, the webworms will strip the plant of leaves and damage subsequent crops. If the alfalfa is a year old or more, it should be given a thorough harrowing after removing the hay. This will wool the worms around in the dust and put a great many of them out of business, and it will give the rest of them a notion that it is about time to move on. A flock of turkeys ranging over the alfalfa field will contribute largely to the prevention of insect damage.

111. A seed crop cannot always be obtained with certainty from alfalfa. The second or the third cutting is usually left for seed. In regions with more than thirty inches average annual rainfall, profitable seed crops are obtained only in dry years. Conditions of the soil as to moisture must determine, at the time al-

falfa is coming into bloom, whether the alfalfa should be cut for hay or left for seed. A strong, vigorous growth of plants and a soil full of moisture do not give ideal conditions for seed production. Instead, the best yields of seed are obtained from a rather short growth and moderately dry soil. Heavy rains coming while a short growth of alfalfa is in bloom may force new growth which, coming up among the old growth, will prevent the formation and curing of a good seed crop. It requires about the time necessary for the growth of two cuttings of alfalfa hay to grow and mature a crop of seed. With this, as with all other phases of the management of alfalfa, the exercise of knowledge and judgment by the man in charge is necessary and no rules can be followed. When obtained, a seed crop is very profitable. In the season of 1911, yields as high as twelve bushels of alfalfa seed per acre were reported from small areas in Oklahoma, and large crops of from five to ten bushels per acre were frequent. But on the average, from two to five bushels per acre is a very fair yield.

112. Dodder is a pest of alfalfa when once it gets started. It is a native plant in at least part of Oklahoma but oftener is sown with alfalfa seed. The seed is somewhat similar to that of alfalfa and should be carefully guarded against. After dodder germinates, it twines about the alfalfa stems and takes root in them, becoming

a parasitic growth. Straw or trash should be piled on the small patches of dodder when first noticed, and burned. Seed should never be saved from fields of alfalfa in which there is dodder.

113. Different conditions of soil and climate present different problems in establishing and managing alfalfa. A few such problems have been selected from one year's correspondence with farmers, chiefly in Oklahoma. They may serve to present the various questions in a slightly different form from the foregoing and assist those who are determined to get for themselves a stand of this valuable crop.

114. Alfalfa in rows. "I am farming tight land and am thinking of planting alfalfa in rows and cultivating the same as corn. Is such a plan practicable?"—Texas county, Western Oklahoma. This plan of growing alfalfa is followed with success in Wyoming and is being experimented with by a few in Western Oklahoma. The rows should be not less than thirty inches apart and preferably thirty-six to forty-two inches. The land should be comparatively level. After the alfalfa is established, it should be cultivated shallow after each cutting and then cross-harrowed to keep the land level. Thorough preparation of the soil to get the land in good condition should precede the sowing. (91.)

115. Alfalfa on sod. "I am having some sod broke; it is good alfalfa land and I want eventually to put it in that. Will it do to sow alfalfa without cultivating for at least a year?" —Jackson county, Western Oklahoma. If there is sufficient moisture, there is every reason for expecting that alfalfa will do as well sown on the sod land as after it has been cultivated for a year or two. Many have succeeded in establishing alfalfa on sod land. It should be plowed early at least six inches deep, then thoroughly disked and chopped fine and, if there is enough rain to soak it thoroughly, chances are good for success if the seed is sown early in March in your county. Summer tilling and sowing in the fall will be more certain to kill the native grasses.

116. Alfalfa on sandy land. "I want to sow some alfalfa in the spring on sandy land if conditions will permit. My land had cotton on it the past season. Should the stalks be pulled and removed before plowing, so that the soil will turn over more compactly?"—Logan county, Central Oklahoma. If the land is comparatively level and not ridged up along the cotton rows, it may be just as well to chop the cotton stalks with a stalk cutter and not to plow the sandy soil. Early in February, the land should be disked and harrowed enough to smooth it, and the alfalfa seed should be sown in early March, so as to get it established ahead

of the April winds. If the wind begins drifting the sand, put on a light coat of straw or rotten hay or manure and press it into the soil by running a disk harrow over it, set nearly straight. Usually, fall is better than spring for seeding alfalfa on sandy lands. Each case must be handled separately, and the individual must be prepared to meet emergencies which may arise. Many have succeeded with fall seeding by sowing a small amount of sorghum or broom corn seed or oats with the alfalfa. This comes up and protects against blowing and is killed by frost before it gets big enough to damage the alfalfa. The dead plants protect the surface of the soil through the winter and save the alfalfa until it covers the ground in the spring. Of course, this plan would not work at all with spring seeding, as the sorghum, oats, or broom corn would choke out the alfalfa.

117. Alfalfa on sandy land. "My farm is in the blackjacks, sandy soil. If I prepare for seeding to alfalfa as I would like and there comes a hard rain and wind, I lose out. I have five acres of wheat that my hogs ran on. How will it do to sow alfalfa into this wheat? It is thin on the ground. Would it be better to prepare the land and sow a few oats with the alfalfa? It is a waste of time and money to sow alfalfa on this land without something to protect it."—Caddo county, Central Oklahoma. You may succeed in getting alfalfa started

where you have wheat by sowing the seed into it late in February or early in March and keeping the stock off. After the wheat and alfalfa get up, the wheat should be cut so as to let the sun shine down to the alfalfa. If you want to sow in the spring, this plan is as likely to succeed as any.

118. Alfalfa in orchard. "Will alfalfa injure apple, pear, or other fruit trees?"—Major county, Western Oklahoma. Alfalfa will almost certainly kill fruit trees if established in the orchard. It is possible that it might not kill pear trees but, in general, the orchard is the last place alfalfa should be sown and then only after it has been determined that the orchard is not wanted any longer. Alfalfa is able to withstand the effect of drouth because of the long tap root which it sends into the subsoil. In seasons when the trees are short of moisture for maturing fruit and keeping alive, the alfalfa will already have exhausted much of the limited supply and the trees will perish.

119. In kafircorn stubble. "Last March, I plowed and planted ten acres of kafircorn and cowpeas alternately. By the time the kafir got up, the sandburrs had sodded. I let the whole mess go until July, plowed the stuff under, double harrowed, and sowed kafir and cane for feed; cut and stacked the last of October. This left the ground clean. With so much moisture in the ground, it appears to be my chance for

ten more acres of alfalfa. Would it be advisable to sow right in where I cut off the feed? The soil is sandy loam and is nice and loose. The ground had two good plowings last year. It has been snowing here for twenty-four hours and we had seven feet of moisture before it began.''—Ellis county, Western Oklahoma. This is a good chance for establishing alfalfa on sandy soil. Alfalfa should be sown into the stubble without any preparation and the earlier it is sown and misses a freeze, the better will be the chance for alfalfa getting established and overcoming the sand burrs. With abundant moisture and a sandy soil, the stubble left on the land will be of advantage in preventing blowing.

120. In humid climate. ''I have black sandy loam with yellow clay foundation, prairie bottom land; also some sandy mountain land with red clay foundation. Will either do to sow to alfalfa?''—Muskogee county, Eastern Oklahoma. If the prairie bottom land is well drained and does not overflow, it is the land on which you should endeavor to establish alfalfa. This soil may be sour and if it is, ground limestone should be applied at the rate of about a ton to the acre. If the land is weedy, it probably would be well to put it to oats, plow as soon as the oats are cut, and work it down to a firm seed bed so that the alfalfa may be sown as early in September as there is sufficient moisture.

You will probably obtain better results from fall sowing than from spring sowing in Muskogee county.

121. In kafircorn stubble. "I have a piece of bottom land which I wish to get set to alfalfa. I sowed this land to alfalfa in the spring of 1909 but did not get a good stand, so I plowed it up in the spring of 1911 and planted corn. When the corn failed, we planted cane and kafircorn. This land was well plowed last spring and is clean but it was too dry to fall plow and now it is too wet. Will it do to disk thoroughly and sow alfalfa this spring without plowing it again?"—Tillman county, Western Oklahoma. With such an abundance of moisture, it is possible that you may be able to get this land in shape for sowing without plowing. The stubble of the sorghum and kafircorn should be disked out as soon as you possibly can and this should be followed by a sufficient number of harrowings to put the surface in condition for sowing. With enough rain to settle the soil loosened by the disking, the land should be in good shape for sowing to alfalfa early in March.

122. Oats after alfalfa. "I have thinned one piece of my alfalfa with hogs and have plowed it up, but it was not wet enough to plow more than three or four inches deep. Will that do for oats? I want a sowed crop so as to fall plow and get it back to alfalfa the following spring. This piece of land has been in alfalfa

four years; has been farmed since 1896, and had been plowed from eight to ten inches deep before seeding to alfalfa."—Custer county, Western Oklahoma. The old alfalfa field which has been plowed shallow ought to be in good condition for seeding to oats by the last of February; in better condition, perhaps, than if it had been plowed deeper. If you can get the oats stubble plowed deep soon after harvesting, you may be able to get the land in shape for fall seeding to alfalfa and thus gain a little time. If conditions for fall seeding are not good, the land will be in the best of condition for spring seeding.

123. Alfalfa in wheat. "I have a field in wheat and want to put it in alfalfa. The ground is in good shape and there is a good stand of wheat. Will it pay me to sow alfalfa in the wheat this spring? Or would I better wait until fall?"—Kingfisher county, Central Oklahoma. It certainly will not pay to sow alfalfa in wheat. The stubble should be disked as the wheat is being cut, and the land plowed and prepared for fall seeding.

124. Alfalfa after cowpeas. "I have cowpeas on some land which I want to sow to alfalfa this fall; also some rotten manure mixed with dirt out in the cow lot. Will it do to plow the cowpeas and manure under or is it better to make hay of the cowpeas and disk the manure in?"—Cleveland county, Central Oklahoma. It will

be better to remove the cowpeas and use them for hay, and then disk in the manure. It will not be possible to get a properly firmed seed bed for fall seeding if the cowpeas are plowed under. Turning the cowpeas and manure under early in the fall will put the land in good condition for spring seeding.

125. Alfalfa in oats. "I have forty acres of old land which I sowed to oats about January 1st. They are coming up fine and not hurt by the freeze. What would you think of sowing alfalfa right on the oats? This is sometimes done and it does look as if, with this wet season, it will be the thing to do."—Jackson county, Western Oklahoma. Usually it is poor business to sow alfalfa with oats or into oats. But with an excellent supply of moisture, it seems a shame to miss a chance of getting alfalfa established. If you want to risk it, sow the alfalfa about the last of February. Later, if the oats appear to be interfering with the growth of the alfalfa, cut them for hay rather than wait for the crop to mature grain. This will be taking a chance but it is probably worth the taking.

126. Reseeding in spring. "Last summer, right after harvest, I plowed seven acres of wheat stubbles deep for alfalfa and harrowed twice right after plowing. That was during the first days of July. About the middle of August, we had a pretty fair rain. I harrowed to break the crust, sowed alfalfa seed, and harrowed

again. The grasshoppers were thick here last fall and as soon as the little plants came up, they ate them off. I want to sow the same piece again this spring. Some of my neighbors tell me I should double-disk it, but I am afraid that will stir the soil up too deep. I intend to plow it shallow, only two inches deep, just enough to give the little roots a good start, because the soil is plenty moist this spring. Which is the best, double disking or plowing two to three inches deep?"—Garfield county, Central Oklahoma. This is a typical case; there were many hundreds like it in the spring of 1912. The land should be neither plowed nor disked. As soon as dry enough in March, it should be given a very shallow harrowing with the teeth set slanting so as to make little furrows. Then a cross-harrowing will cover the broadcasted seed. Or the seed may be drilled into the soil without any harrowing. One of the most common causes of failure to get a stand of alfalfa is sowing on a loose seed bed. All that is needed is enough loose soil to cover the seed not over an inch deep. The disk harrow should never be used on land to be sown to alfalfa except to pack the soil immediately after plowing and fit it for harrowing with the spike-toothed harrow.

127. Alfalfa in rotation. "I have a quarter-section of bottom land which overflows once in six to ten years. About one hundred and forty acres are suitable for cultivation. The general

idea is to grow the maximum number of hogs each year, and to raise enough corn and alfalfa to supply them. Will you be kind enough to give me a proper rotation for this place?"—Noble county, Central Oklahoma. The proper rotation for this farm is corn and alfalfa. Some alfalfa should be plowed up each year, planted to corn, and a like acreage of alfalfa sown. Through a series of years, both corn and alfalfa will thus be grown all over the place to the advantage of both. In years of overflow which killed some alfalfa, the corn acreage probably would be large. It will likely be profitable to grow considerable alfalfa, buying the additional corn necessary to finish off the hogs which are largely grown on the alfalfa. Some kafircorn should also be grown every year.

128. Alfalfa and barley. "I want to get alfalfa started but there is no use in sowing here in the spring unless a nurse crop is used to keep out weeds and crabgrass. One seed house recommends sowing in the spring, using barley as a nurse crop. Will that work here? I think it is best to sow alfalfa in the fall here. Crabgrass grew knee high here since harvest and you can guess how alfalfa would look in such a mess."—Rogers county, Eastern Oklahoma. Land which is so foul as to make a nurse crop seem desirable for alfalfa is not in good condition for seeding to alfalfa. Crabgrass will be ready to do business just the same after the

barley or other nurse crop is cut, and the nurse crop will have prevented the development of the alfalfa during the cool weather before the crabgrass starts. Such land should be cultivated to get it as clean as possible and prepared for fall seeding.

129. Alfalfa dying out. "I have twenty-five acres of old alfalfa and twelve of last spring's seeding with a perfect stand on all of it. About two years ago, I noticed two streaks appearing in the large piece. They don't show much in the first two cuttings but when hot weather comes, and especially if it is a little dry, they are very noticeable, scarcely making any hay at all. These streaks are growing larger each year. This spring, the plants in them are apparently dead but I find by close examination that the roots are putting out buds under the ground so I guess they will start up after a while. The soil is rich, black, sandy loam with no gumbo or hard-pan. Some say alfalfa naturally runs out in from six to ten years and others say the roots reaching hard material causes these streaks. Please give me your opinion."—Kay county, Central Oklahoma. It would be nothing but a guess to attempt to explain the trouble which you are having with your alfalfa dying out in streaks. Alfalfa under normal conditions does not run out if it has good care and the soil is favorable. It should continue being productive for twenty-five years or more. It will pay, how-

ever, to plow up alfalfa when for any reason the stand becomes thin, and to rotate it with corn or other crops before reseeding.

130. Alfalfa bacteria. "Where can I get alfalfa bacteria to use with the seed when sowing and do you think inoculation necessary to success? The soil is sandy. Where should I send a sample of soil to have it analyzed to know what crops will do best and how much soil should I send?"—Woodward county, Western Oklahoma. The only reliable place from which to obtain alfalfa bacteria is from a good field of alfalfa where the roots have an abundance of nodules on them. If you will sow about one hundred pounds to the acre of soil from such a field on the land which you expect to put to alfalfa, you will have done all of the inoculating which you can do. Artificial inoculation is not at all necessary to success with alfalfa on suitable soils in your county. The best analysis is to prepare the land and sow the alfalfa. No soil analysis will tell, for practical purposes, what crops will do best. One thing which your sandy soil needs is humus and you can obtain this by growing cowpeas and plowing them under as preparation of the soil for alfalfa. If the cowpeas are plowed under during the early fall, the land can be got into good shape for spring seeding.

131. Seed testing. "Where can I have alfalfa seed examined to find out what weed seed it con-

tains and what percent. of the alfalfa seed will grow?"—Baylor county, Texas. You should send an ounce sample of the alfalfa seed to the Experiment Station, College Station, Texas. It takes about ten days to do this work and there should be no charge for it. Kansas farmers should send samples to the Experiment Station, Manhattan, Kansas; Oklahoma farmers to the Experiment Station, Stillwater, Oklahoma; Arkansas farmers to the Experiment Station, Fayetteville, Arkansas.

132. Cultivating alfalfa. "For cultivating alfalfa, is the spike-tooth disk the best at all times, or is the common disk better sometimes, especially when grass is coming up? Please tell when and how to cultivate it to get best results."—Garfield county, Central Oklahoma. The spike-tooth disk harrow is more satisfactory than the solid disk harrow for cultivating alfalfa and cleaning out the grass. As a rule, alfalfa should be cultivated in March just as growth is starting and after each cutting if thought necessary. The disking should not be heavy, especially until after the alfalfa is two years old. Good work can be done with a weighted smoothing harrow.

133. Johnson grass and alfalfa. "I have some Johnson grass on overflow land. Could I sow alfalfa on the ground and kill the Johnson grass? Sowing it to alfalfa is the easiest way I can manage it if the overflow will not kill the

alfalfa. Will it do it?"—Kay county, Central Oklahoma. It is not at all certain that alfalfa will kill out Johnson grass under all conditions, though it has disposed of some thin stands. A good stand of alfalfa will withstand a considerable amount of overflow as long as the water keeps moving. If the water stands quietly on alfalfa for much longer than twenty-four hours, the alfalfa is usually killed.

134. Breaking a crust. "If a hard rain should come after seeding and make a crust, should this be harrowed or will the alfalfa break the crust and come through? How soon after alfalfa comes up should I use the harrow and will it pay me to get an alfalfa disk harrow? If so, how soon should I use it?"—Pottawatomie county, Central Oklahoma. If a heavy rain forms a crust immediately after sowing alfalfa, there is little that can be done to overcome the difficulty. It is not safe to harrow, as the alfalfa seed will have germinated and the stand will likely be lost. About all that can be done is to hope for a shower that will moisten the crust and let the alfalfa out. Alfalfa should not be harrowed until it is about a year old. On many soils, it is not necessary to cultivate alfalfa. When the soil becomes compacted by pasturing or when crabgrass gets started, a spike-tooth disk harrow is needed.

135. Thickening thin alfalfa. "How can I get a better stand of alfalfa after it has been

seeded three years? It is thin in spots."—Payne county, Central Oklahoma. It is very difficult to thicken a stand of alfalfa after it is more than one year old. If seed is sown, the little plants are shaded out by the larger ones which are well established and draw heavily upon the moisture in the soil. If the stand is too thin to give profitable yields of hay, the best thing to do is to plow it up and reseed.

"I sowed twenty-eight acres of alfalfa March 23, 1911. The weeds and dry weather killed it in spots. Can I sow more seed in the spring of 1912 and hope to thicken my stand? There is a fine season in the ground and it is loose and mellow on top. I would have resowed in the fall of 1911 but the land was too dry."—Tillman county, Western Oklahoma. You now have your last chance to thicken this thin stand of alfalfa. Five to ten pounds of alfalfa seed per acre should be drilled or broadcasted and harrowed in early March. This will give the alfalfa a chance to catch up with that which is older, and while you may not be entirely successful, the chances are that the stand will be improved.

"On the first of October, I sowed ten acres of alfalfa. The freeze in November killed out one-third of it. The ground is in fine condition. Will it do to harrow lightly and sow again in March, not using as much seed, then harrow again after sowing?"—Tulsa county, Eastern Oklahoma. This plan of thickening thin alfalfa

is exactly right. It may not be necessary to harrow before sowing unless there is a crust on the soil.

136. Alfalfa and crabgrass. "I plowed some wheat stubble last summer and the crabgrass came up on it about knee high. Will it be best to plow again for seeding to alfalfa in the spring, or could I burn the grass off, and get a better and firmer seed bed by harrowing? It wasn't plowed very deep."—Rogers county, Eastern Oklahoma. The land should be put to some spring crop such as oats, rather than to attempt to get it ready for spring seeding to alfalfa with so much crabgrass in the soil. The crabgrass will almost certainly come up and crowd out the alfalfa. You missed an excellent chance when you failed to cultivate this land and keep the crabgrass down last fall. Plow this land as early as possible and sow it to oats. Disk the oats stubble immediately after the crop is cut and plow deep as soon as possible. Keep harrowing and allow no weeds or grass to become established. Sow to alfalfa between August 15 and September 20, as soon as there is enough moisture in the soil to germinate the seed and sustain the plants for a month without rain.

137. Water near surface. "I have sixty acres of good bottom land along the North Canadian river but some tell me that water is so close to

the surface that it will not grow alfalfa. The water is from three to five feet below the surface. I have some sub-irrigated land which is higher, but is sandy, a dark red color."—Woodward county, Western Oklahoma. If the water never gets closer to the surface than three feet, you will be able to establish alfalfa and maintain it profitably for several years. If, during a very wet season, the water should come to the surface of the soil and stay there for any length of time, the alfalfa will be killed. Usually, it is well for water to be not closer than five to ten feet from the surface of land where alfalfa is sown.

138. Poisoning gophers. "I would like to know of some sure and simple way of getting rid of gophers in alfalfa."—Okfuskee county, Eastern Oklahoma. Get some raisins, cut a little slit in each raisin and insert a small crystal of strychnine sulphate. Keep these poisoned raisins in a can where there is no possibility of the children getting them. Take a sharp pointed stick (it is better if shod with iron) and punch holes between two fresh gopher mounds until the runway is located. Drop in a poisoned raisin and plug the hole with a clod. Do this all over the field where gophers are at work and level off the mounds so that new ones may easily be seen. After about a week, repeat the operation, and if the work has been

done carefully, that will be the finish of the gophers for quite a while. Whenever any show up, give them another dose.

139. Dodder in alfalfa. "Will you please tell me how to detect the presence of dodder in growing alfalfa? I have inquired of a dozen alfalfa men and could not find one who had ever seen any of it. What does it look like? We may have it and not know it."—Grant county, Central Oklahoma. The presence of dodder is shown by yellowish patches in the alfalfa field. When examined, the yellowish color will be found to be due to a vine which twines about the stems of the alfalfa and seems to have no connection with the soil. If at the right stage, the vines will be producing seed pods. On opening them you will find seed quite similar to alfalfa seed in appearance. These seeds germinate in the soil and after the dodder plants come up, they attach themselves to the alfalfa and live off the juices of the alfalfa plants, thus weakening and killing them. The way to kill dodder is to kill it. This can be best done by piling straw on the patches where dodder appears and burning it. If the patches are very small, they may be killed out by cutting and carefully removing the alfalfa plants to which the dodder has become attached, being very careful not to drop any dodder seed.

140. Curing alfalfa hay. "How should I handle alfalfa hay from the time it is cut to

keep it from coming out of the mow musty and moldy?"—Kay county, Central Oklahoma. If alfalfa hay, as soon as it is well wilted, is turned into windrows with a side delivery rake and allowed to cure there until no juice can be squeezed out of the stems by tightly twisting a bunch of them, there should be no trouble from the hay becoming musty in the mow. There are those who say they put alfalfa hay into the mow green and pay no attention to whether or not it is dry enough; but the average individual with human limitations will find it desirable and necessary to have alfalfa hay as dry as it can be got, without losing leaves in handling, before storing it away.

141. Irrigating alfalfa. "I have forty acres of alfalfa land which can be irrigated by raising the water about twenty feet. Will it pay to irrigate it? When should the water be turned on a seed crop of alfalfa and how long should the water remain on?"—Kay county, Central Oklahoma. It is entirely practicable to pump water to a height of twenty feet for the irrigation of alfalfa. A gasoline engine and a centrifugal pump will lift water that high economically. Alfalfa should be irrigated immediately after cutting and removing the hay. An irrigation of one to two inches at this time should be sufficient to produce a crop of hay and often no irrigation at all is necessary in your county. Ordinarily, there is too much moisture in the

soil for the production of a first class seed crop in Kay county and irrigation for this purpose in a dry season should be very light.

142. Turkestan alfalfa. "I should like your opinion on trying to grow Turkestan alfalfa on some of our uplands. I have grown alfalfa on upland very successfully by specially preparing the land and fertilizing heavily. Is there any difference in the feeding value of Turkestan and common alfalfa?"—Cleveland county, Central Oklahoma. It will not be profitable for you to waste time with the variety of alfalfa called Turkestan. Trials of it in Oklahoma have shown that it does not produce as well as alfalfa which has become acclimated to Oklahoma conditions. The best alfalfa seed for you to sow on uplands is seed produced on similar soils in your locality, if it can be obtained. There is practically no difference in the feeding value of the two varieties, but there is considerable difference in the yield and it is in favor of your locally grown alfalfa.

143. Alfalfa in Arkansas. "I have seven acres of bottom land which I want to sow to alfalfa. It is of a black, waxey, wet nature. It was sowed to wheat last fall. Will it do for alfalfa? Can I sow it in the spring and harrow it in with the wheat?"—Boone county, Arkansas. You will not have one chance in ten of obtaining a stand of alfalfa if you sow it with wheat in the spring. Land naturally wet is not

adapted to alfalfa growing unless it is drained so that water never rises closer than five feet from the surface, and preferably never closer than ten feet. If the soil is suitable, it should be plowed as soon as wheat is harvested and harrowed thoroughly until the seed bed is well settled. Twenty pounds of alfalfa seed should be sown to the acre at any time after August 1st that the soil is filled with moisture.

"I have a field of bottom land which is a loose, sandy, level loam. I am thinking of trying alfalfa. We are living on the James Fork bottom and no one is growing alfalfa around here. Do you think it is worth trying?"—Sebastian county, Arkansas. If the land is well drained, it most certainly will grow alfalfa profitably, provided it is not subject to prolonged overflow. It certainly is well worth trying. In your locality, it may be well to apply lime or ground limestone to the soil before sowing alfalfa.

144. Measuring stacked hay. "Can you give me a good rule to measure hay in the stack when well settled?"—Alfalfa county, Western Oklahoma. The following is one of the usual rules: To determine the number of cubic feet in a stack of hay, measure the distance from the ground on one side of the stack to the ground on the other side. Subtract the width of the stack from this. Divide the remainder by the height of the stack. Multiply this figure by the distance from the

ground on one side of the stack to the ground on the other side; then multiply by the width; then multiply by the length; and then multiply by 0.225. This will give the number of cubic feet. Divide this by 380, the average number of cubic feet in a ton of well settled hay, and you will have the number of tons in the stack, as nearly as it is possible to estimate it.

145. Grades of alfalfa hay. The following is the classification adopted by the National Hay Association in 1905:

"Choice Alfalfa—Shall be reasonably fine, leafy alfalfa, of bright green color, properly cured, sound, sweet, and well baled.

"No. 1 Alfalfa—Shall be coarse alfalfa of bright green color, or reasonably fine, leafy, of good color, and may contain five percent. of foreign grasses; must be well baled, sound, and sweet.

"No. 2 Alfalfa—Shall include alfalfa somewhat bleached, but of fair color, reasonably leafy, not more than one-eighth foreign grasses, sound and well baled.

"No. 3 Alfalfa—Shall include bleached alfalfa, or alfalfa mixed with not to exceed one-fourth foreign grasses, but when mixed must be of fair color, sound, and well baled.

"No Grade Alfalfa—Shall include all alfalfa not good enough for other grades, caked, musty, grassy, or threshed."

146. The best market for alfalfa hay is good

livestock on the farm which produced it. Discussing this point, Director Webster of the Kansas Agricultural Experiment Station said: "We are not getting what we should from our alfalfa. Located as we are, we have naturally come to making alfalfa a commercial crop. We have mills which grind alfalfa which, with the baled crop, is shipped to other states in amazing amounts. Kansas farmers cannot afford to sell their alfalfa outside of the state. If the eastern feeder, who is glad to get our alfalfa at three times the price we get for it, can put it into his barn for feed and sell the finished product profitably, then the Kansas farmer is losing the difference when he might as well be putting the finished product on the market himself."

147. The best alfalfa mill is good livestock which can grind alfalfa hay more economically than any machine which has yet been built. The business of milling alfalfa is coming to be a profitable adjunct to the business of milling wheat, kafircorn, and other grains. There is where it belongs. The livestock markets at Kansas City, Wichita, Oklahoma City, and Fort Worth furnish the places where farmers of the Central Southwest may market the only alfalfa mills likely to bring them a profit—the fat cattle and hogs and livestock products. Investments in good livestock are many times more likely to pay profits than are investments

in beautifully engraved certificates of stock in alfalfa mills, whether paid for in cash or in alfalfa hay.

148. Judicious pasturing of alfalfa is profitable. Alfalfa less than a year old should not be pastured at all; it needs at least that much time for getting well established. Alfalfa is a hay crop rather than a pasture crop. But pasturing combined with the production of hay may be made to give the greatest profits. If possible to avoid it, alfalfa should not be pastured so heavily that two to three good cuttings of hay are not produced each season, in addition to the pasture. Heavy pasturing makes the stand thin and gives grass and weeds a chance to become established.

149. In the spring, when growth is starting, one month of heavy pasturing may damage a stand of alfalfa more than pasturing it heavily the other eleven months. The plants must have a chance to recuperate. If the leaves are nipped off as rapidly as they appear when growth starts in the spring, the plants are discouraged and the weaker ones die. If stock are taken off by March 1st, and the alfalfa is given a good cultivation, with an alfalfa cultivator or a smoothing harrow heavily weighted, the plants will be strengthened and will start into vigorous growth when warm days come. The bacteria in the nodules on alfalfa roots can get no nitrogen from the air unless air gets into the

soil. A cultivation which will loosen the surface soil without doing damage to the plants should be given at least once a year to all alfalfa which is pastured. The egg cases of grasshoppers will be thrown out and destroyed. Moisture will be saved to push the growth of the crop instead of being permitted to evaporate from the compacted surface.

150. Hogs pastured on alfalfa will make more profitable growth if fed a ration of kafircorn, milomaize, or corn in addition to the pasture. It is possible to maintain hogs on alfalfa pasture alone, but it is not possible to finish them for market without the feeding of grain. The Nebraska Experiment Station has thoroughly investigated the uses of alfalfa in feeding hogs. In one experiment, four lots of ten pigs each, averaging about 75 pounds, were pastured on alfalfa. One lot received no corn, the other lots ate respectively 1.33, 2.48, and 3.46 pounds of corn per pig per day. The daily gains per pig in each of the four lots during a period of sixty days were 0.02, 0.34, 0.63, and 0.85 pounds. Figuring the alfalfa pasture at $2 per acre for each lot and corn at market prices, thirty cents per bushel, the cost of 100 pounds of gain for the different lots was: $14.30; $2.74; $2.45; and $2.43. Many with a considerable acreage of alfalfa have made the mistake of raising more hogs on alfalfa than they could obtain grain to finish. This has happened several times, es-

pecially in localities which have depended upon growing corn and have not planted good acreages of those sure grain crops, kafircorn and milomaize. Except scabby ears on thin-skinned shoats allowed to run in wet alfalfa, there is rarely trouble of any sort from pasturing alfalfa with hogs. This should be treated with a solution of one of the coal tar dips used according to directions on the package.

151. Bloat of cattle sometimes results when they are first turned on alfalfa pasture or when it is wet. A mixed stand of alfalfa and crabgrass or other grasses is more satisfactory as cattle pasture than a first class stand of alfalfa. While many pasture both horses and cattle on alfalfa with profitable returns and few or no losses, the first purpose and greatest value of alfalfa is not for pasture. Those who grow the crop successfully for hay may work into pasturing gradually. But those who expect to grow it for pasture as the first consideration are not likely to find it satisfactory.

152. In composition and actual feeding value, a ton of good alfalfa hay is fully the equal of 1600 pounds of wheat bran. One hundred pounds of alfalfa hay contain 11.1 pounds of digestible protein, 39.1 pounds of digestible carbohydrates, and 0.6 pounds digestible fat. One hundred pounds of wheat bran contain 11.9 pounds digestible protein, 42.0 pounds digestible carbohydrates, and 2.5 pounds digestible

fat. For all practical purposes, results from feeding alfalfa in combination with other feeds will be entirely satisfactory if practically the same methods are used as are customary when feeding wheat bran. No one experienced in feeding would think of giving any animal nothing but bran; neither should they have nothing but alfalfa but, because of its bulkiness, the exclusive feeding of alfalfa is not as harmful as the exclusive feeding of bran would be. All animals fed alfalfa should also be fed ground kafircorn or milomaize or Indian corn. There is no need for buying and feeding bran, shorts, or cottonseed meal when alfalfa hay is on hand. Whenever a ton of alfalfa hay sells for less than the cost of 1600 pounds of bran, alfalfa is the cheaper feed for every kind of farm livestock.

153. The fertilizer constituents in a ton of alfalfa hay are 49.4 pounds nitrogen, 35.8 pounds potash, and 12.2 pounds phosphoric acid. If bought in the form of commercial fertilizers, this will cost at least $9.80. When alfalfa hay is sold, even at fifteen dollars per ton, two-thirds of the cash received is drawn from the supply of fertility of the farm which produced it. It is true that a large part of the nitrogen of alfalfa is taken from the air through the work of the bacteria in the nodules on the roots. But the potash and the phosphoric acid all comes from the soil, much of it being drawn from the subsoil at depths not reached by other crops. Sold at the usual prices, this fertility is

given to the lands of others. Fed on the farms which produce it, alfalfa hay builds the fertility of the soil and makes possible increasing yields of other crops. Sold, alfalfa is a soil robber; fed, it is a soil enricher. The man who grows alfalfa and sells the hay is wasting his patrimony without getting even the questionable pleasure of riotous living out of it.

154. For horses, alfalfa hay is an entirely satisfactory and valuable feed if used with any degree of judgment. Keeping in mind the fact that in composition, alfalfa hay is practically the same as bran, only limited amounts should be fed at first. Alfalfa hay should not be fed alone to work horses and brood mares, any more than bran should be fed alone. When alfalfa hay is fed, the grain ration may consist entirely of kafircorn, milomaize, or corn, and other hay should be fed, at least until the horses become entirely accustomed to alfalfa. The amount of alfalfa fed per day to a horse should be limited to ten to fifteen pounds. In regions of heavy alfalfa production, no other hay than alfalfa is fed and fine horses are produced. Many breeders of pure-bred Percherons make large use of alfalfa as feed for their brood mares, colts, and stallions.

155. Cattle feeding offers a field for the profitable utilization of large amounts of alfalfa hay. The proper production and use of kafircorn, milomaize, and alfalfa in beef production by the

farmers of the Central Southwest will make this region practically independent of drouth. The use of alfalfa hay in connection with these grains in fattening steers has already been discussed (26). Steers on full feed of ground kafircorn or milomaize will consume from ten to fifteen pounds of alfalfa hay per day per head. Stock cattle may be maintained and will keep in good condition on alfalfa hay, either alone or with but little grain. Alfalfa hay damaged by rain should never be destroyed; it never gets so badly spoiled that cattle will not eat it.

156. In the dairy ration, alfalfa effects a great saving in the cost of production (27). Alfalfa may constitute the entire hay ration of dairy cows being fed liberally on ground kafircorn or milomaize. Under farm conditions, when alfalfa hay is produced, there is no need of purchasing bran, shorts, or cottonseed meal for dairy cattle. With cows producing large amounts of milk, and requiring correspondingly large quantities of feed, some of these concentrated feeds may be used to replace a portion of the more bulky alfalfa hay.

157. Feeding hay to hogs is regarded as something of a joke by those uninformed as to the value of alfalfa hay in reducing the cost of the production of pork. But for many years, practical feeders have used large amounts of alfalfa with profit in hog feeding. The Nebraska Agri-

cultural Experiment Station has reported the results of numerous experiments in hog feeding where alfalfa was a part of the ration. The most satisfactory ration, judged from the profit made per hog fattened, was corn and all of the alfalfa hay, fed from the rack, that the hogs would eat. This method turned off more net profit than when the alfalfa was chopped or ground to meal before feeding. The conclusions are: "After studying, for several years, the problem of feeding alfalfa hay to hogs, we would recommend the following:

"Feed a good quality of fourth cutting if possible. If this cannot be obtained, feed the finest and brightest hay possible.

"Feed the hay in a rack from which it may be eaten easily, or feed twice or three times daily, on hard soil or on a feeding floor, throwing aside the refuse left over from the last feed.

"Give the hogs an abundance of alfalfa. Do not try to make them eat the coarse stems. They will eat corn in preference and not eat as much alfalfa as is desirable. Feed the coarse stems to the cattle and horses." (29.)

158. For poultry feeding, alfalfa is coming into increasing use. The leaves are used in making mixtures of feed for growing poultry and laying hens. The protein of the alfalfa furnishes a portion of the nitrogenous material required for the formation of the albumen of the eggs. Alfalfa pastures for poultry are also coming into use.

159. Bee-keeping is a most profitable adjunct to alfalfa raising; profitable to the beekeeper in the production of excellent honey and to the alfalfa grower in the more perfect fertilization of the seed crop.

COWPEAS

160. Cowpeas in the south have for many years been grown quite extensively. Those who have come from the humid southern states to farm under the semi-arid conditons of the Central Southwest have found it necessary to make many changes from their accustomed methods of cropping. The common practice of sowing cowpeas among the corn, which brings profitable results in the Atlantic coast states, is not satisfactory here. Cowpeas pay better when handled, at least in part, as a real crop instead of as a catch crop.

161. Cowpeas replace clover in crop rotations here. Farmers from northern states, accustomed to growing clover, have found the crop unprofitable in the southwest. As they have learned to make use of cowpeas instead of clover, they have found that cowpeas will do as much in the way of soil improvement and the production of feed in four months as clover will do in eighteen months, even under conditions most favorable for the growth of clover. A realization of this fact in the northern states, even where clover does well, is causing a more

extended use of cowpeas and a reduction of the clover acreage on many farms. Cowpeas obtain from the air a portion of the nitrogen required for their growth. The same is true of clover and it is this feature which makes the crop of value in the maintenance of soil fertility.

162. On upland soils, not well suited to the production of alfalfa, cowpeas may be grown and will supply feed fully the equal of alfalfa hay for all purposes. From cowpea hay and kafircorn or milomaize, rations may be provided for cattle, horses, and hogs fully equal in ability to produce profitable results with rations composed of alfalfa hay and corn. These sure feed crops make it possible for farmers on relatively poor soils to engage in stock raising with the certainty of profit.

163. Cowpeas require cultivation and, in regions with limited rainfall, rarely produce profitable crops when broadcasted or drilled thickly. Land to be planted to cowpeas should have good preparation, the same as for any other real crop. Usually, the rows should be the standard width, forty-two inches apart. In locations with plenty of moisture, they are sometimes "double-rowed" when planted with a two-row corn planter, making the rows twenty-one inches apart. This is too close, however, for satisfactory cultivation or for certainty of yields in dry seasons.

164. A crop of cowpeas should be grown at least once in three years on all cultivated land. The crops grown will determine where cowpeas can most profitably be worked into the rotation. This will be indicated to some degree in what follows. Continuous planting of any one crop on the soil, without a change, inevitably results in decreased yields. If the chief crop is wheat, a portion of the stubble should be disked as the wheat is cut and planted to cowpeas in shallow furrows, this land to be planted to oats, kafircorn, or milomaize the following spring. If cotton is the principal crop, not all of the cotton land should be replanted to cotton the following spring. Instead, part of it should be planted to sure feed crops, among which cowpeas should be included.

165. Alternate rows of cowpeas and kafircorn, or milomaize furnish a practicable way of growing these crops, insuring good yields, and at the same time keeping up the soil's fertility. The kafircorn, for example, is planted at the usual time for the locality, but the rows are put seven feet apart. After a cultivation or two with the harrow or cultivator, and perhaps a month later, cowpeas are planted in the middle of the seven-foot strip between the kafircorn rows. After the kafircorn gets too big to straddle with the cultivator, cultivation of the cowpeas should be continued. The following year, the rows should be reversed, kafircorn

being planted in the rows where the cowpeas grew the previous year.

166. A peck of cowpea seed to the acre is enough. Cowpea seed are usually high in price, ranging from $1.50 to $3.50 per bushel and even higher at the close of the planting season. Thickly planted, cowpeas will make but poor growth in a dry season. If thinly planted, there will be plants enough in a dry season and these will grow large enough to occupy the space in wet seasons. Many failures with cowpeas have been caused by planting them too thickly. A peck to the acre is always enough. At that rate of seeding, the cost of seed per acre is light.

167. The soil should be warm before cowpeas are planted. The seed quickly rots if placed in a wet, cold soil. They germinate quickly with proper conditions of warmth and moisture. In Oklahoma, May 1st in the southern part of the state, and June 1st along the northern border, are the earliest dates for planting cowpeas. The early varieties furnish the earliest grain pasture for hogs. To make sure of a crop, the planting should be completed if possible by July 1, though fair yields are sometimes obtained from planting as late as July 15. Usually, there is not enough moisture to give the crop a good start if planting is delayed until July.

168. As a catch crop, planted on wheat or oats stubble, cowpeas are not always certain

to pay. Unless there is abundant moisture in June and the crop is put in early, a dry July may make the crop a complete failure. In favorable years, however, good crops have been raised by planting cowpeas into disked stubble land. Cotton sometimes fails to make a stand. Late replanting is rarely profitable, but there is usually time to plant cowpeas after the cotton has been abandoned. Early potatoes should be followed by a crop of cowpeas instead of by a second crop of potatoes. Wherever a crop has been removed in time or there is a vacant patch of land in June, it should be put to use growing cowpeas instead of being permitted to grow up to weeds.

169. For green manuring, to be plowed under for soil improvement, cowpeas are a profitable crop. They should be turned under when the plant is at the highest stage of growth, just before it begins maturing. This will actually add to the supply of plant food in the soil, some of the nitrogen of the plants being obtained from the air through the action of the bacteria in the nodules on the cowpea roots. The vegetable matter after it decays will also improve the soil and make it work better. If the soil is sandy, the soil grains will be held together by the decayed cowpeas and will have less of a tendency to blow. If the soil is tough and pasty, it will be loosened to some extent and work better. As a rule, land where cowpeas have been turned under in August or September

should not be sowed to wheat or alfalfa in the fall but should instead be planted to crops the next spring. It takes time for the material to decay and the soil to settle to a good seed bed. Wheat may be sown on land from which a crop of early cowpeas has been pastured off or cut for hay.

170. Good feed is wasted, however, when a crop of cowpeas is plowed under. It is more profitable to get their full feeding value, if possible, and put the resulting manure on the land. Cattle may be pastured on cowpeas with profit if care to prevent bloat is taken when they are first turned in. They should be turned in at first in the evening for a short time until they become accustomed to the large supply of rich feed. Hogs often do not pasture satisfactorily on cowpeas, especially if turned in before any of the pods have ripened. They may dig up and eat the roots, leaving the tops to waste. But there is no more economical way of harvesting a cowpea crop than by pasturing it with hogs after most of the pods have matured. Gains will be better if they have a light feed of ground kafircorn or milomaize to balance the ration while pasturing on the cowpeas. Even after the vines have been killed by frost, horses and cattle will continue eating them and hogs will gather the seed.

171. Cowpeas for hay should be cut before the bottom leaves begin drying, while still

blooming at the top but after the pods have begun ripening at the bottom. Cultivation of cowpeas to be cut for hay should be such as to leave the land level and free from ridges. The crop is usually cut with a mower but, if the grain is ripened, this shatters much of it. Better work can be done with the mower by using an extension on the guards to lift the vines. The roots may be cut off with a sharp plow with the moldboard removed, or with a sharp iron properly bent and attached to a plow beam. As with alfalfa, the curing is best effected by keeping the leaves alive and transpiring water for as long a time as possible after cutting. After wilting in the swath, the curing should be continued in the windrow and, if necessary, in small piles. The more thoroughly cowpea hay can be cured without losing its leaves, the better the condition in which it will come out of the mow or stack. Cattle will eat badly damaged cowpea hay but its feeding qualities are not improved by its having become mouldy or blackened.

172. The feeding value of cowpea hay for all farm purposes is essentially the same as that of alfalfa hay. (152.) It varies widely, depending upon the amount of matured grain which it contains and the percentage of leaves lost during the curing. Cowpeas contain 16.8 percent. digestible protein, 54.9 percent. digestible carbohydrates, and 1.1 percent. digestible fat. The hay, without the grain, contains 5.8

percent. digestible protein, 39.3 percent. digestible carbohydrates, and 1.3 percent. digestible fat. For horses, dairy cattle, and fattening steers and hogs, cowpea hay may be used for every purpose that alfalfa hay can be used and the results will be practically the same. It is a rich feed, difficult at times to care for and cure properly, but one which should be grown and fed much more extensively as one of the sure feed crops adapted to Central Southwestern conditions.

173. Varieties. Numerous varieties of cowpeas are grown. The Whippoorwill is the most common, though different types are often sold under this name. It is a variety which produces a good growth of vine and a fair yield of seed. W. P. Camp of Washita county, Western Oklahoma, has made variety tests of cowpeas and sums up their general adaptabilities as follows:

For hay—Whippoorwill, Iron, New Era, Warren's New Hybrid, Red Crowder.

For seed—Michigan Favorite, Whippoorwill, Groit, Brabham.

For quick maturity—New Era, Warren's Extra Early, Michigan Favorite, Whippoorwill.

For slow maturity—Red Ripper, King, Unknown, Clay.

For heavy vines—Unknown, Rep Ripper, King, Clay, Brown Crowder. One early and one late variety are desirable on every farm.

174. Cowpea seed are usually high in price because of the labor necessary to save the seed. The ripe pods are picked by hand, children usually doing the work. These are later either hulled with machinery or flailed out. Small hullers, run by hand or a gasoline engine, do satisfactory work. Some seed is saved by storing hay containing ripe seed in mows with tight floors. As the hay is fed cut, the seed are shaken down and later cleaned off of the floor. Special cowpea threshers which thresh the grain from the entire plant without cracking the seed are now coming into more general use. Grain threshers do not do satisfactory work with cowpeas. They crack too large a proportion and spoil them for seed.

175. Weevil damage in cowpea seed is a frequent source of loss. This may be prevented by placing the cowpeas in a tight bin or box and putting in with them, in open dishes or by pouring through a pipe into the middle of the pile, one pound of carbon bi-sulphide for each thirty bushels of grain. The bin should be kept tightly covered and fire should be kept away until the odor disappears. This treatment will kill the weevils and similar treatment two weeks to a month afterward will kill any others which may have hatched out. Another method consists in putting the cowpeas in an air-tight bin, then fill a number of small bottles with carbon bi-sulphide, cutting a notch in the stopper of each.

Set these bottles in the cowpeas and let them keep up continuous treatment for weevil.

176. Practical experience is necessary to adapt the cowpea crop to varying soil conditions. An excellent illustration of this is furnished by the following report from P. R. Slack of Major county, Western Oklahoma:

"A few years ago, I became a convert to the planting of cowpeas and although I have had some partial failures, I have never become a backslider. My farm is in the blackjacks and the soil is very sandy. I cut the cowpeas with a cutter and the fields being left bare of vegetation, how that soil did blow! I had to dig my wire fences out of the sand banks in the spring. But I realized that the fault was not with the cowpeas so I tried drilling the field to wheat or rye, merely as a cover crop after the cowpeas were taken off.

"In the summer of 1911, during the dry, parching weather, my field of cowpeas was a rich, dark green, showing no trace of dry weather, while the corn was parched and suffering for moisture. The soil has been improved by plowing under a green crop of rye or wheat every year on land which was in cowpeas the previous year. The soil did not blow badly in the spring of 1912, even with the bad dust storms we have had.

"To prepare the soil for cowpeas, I plow during May after the other crops are out of the way and the weeds have obtained a good start,

preferably land which was in kafircorn or broom corn the year before, using a chain to wind under all weeds and trash. I follow with a harrow and any time in June, after a good rain or two has settled the soil, list shallow—from two and a half to three inches deep. Make furrows not more than three feet apart. Drill right after the lister so as to put the seed in moist earth, drilling about one peck to the acre, one seed each three to four inches in the row.

"I then cultivate two or three times, bringing the soil to the plants from the first. In hard land, it might be well to plow early, but I wish to get all the humus possible into the soil so prefer to plow after the weeds get a good start. A furrow opener attachment to a corn planter would be a fine thing to use in planting the cowpeas. I have planted cowpeas as late as July 15 and they fully matured a heavy crop of seed. I have also found that those planted after the middle of June remain free from weevil until warm weather the following season, while the early-planted are badly infested during the fall of the year in which they are grown.

"For cutting cowpeas, I use the following: Take an old plowbar and a piece of corn sled steel about twenty-six inches in length to the blacksmith shop and have the steel welded to the bar, at an angle of a little more than forty-five degrees, making the steel of knife lie nearly flat. Put a brace across from bar to knife. Bolt the bar to a riding plow or lister, and put on

your rolling coulter with a crooked shank so as to cut the vines as far from the row as possible. If the soil is hard or dry, the lever can be set to cut at the surface; if loose and sandy, it should be set to cut under the surface.

"In our dry climate, I always cure cowpea hay in the shock, shocking immediately after the cutter and putting about eight rows in one shock row. If I can get help, I prefer shocking entirely by hand, as many cowpeas are lost in raking. In favorable weather, the crop will cure enough to stack in three weeks. In regions of greater rainfall, shocks should be made smaller and high and narrow. The hay will not shed water readily and should be stored in a mow or the stacks should be covered with some material which will shed water.

"I plant the Speckled Crowder exclusively, as it yields fully a half more seed than any other variety I have tried, besides yielding a heavy crop of hay."

PEANUTS

177. Peanuts earned a place among the sure feed crops in Oklahoma in the dry season of 1911. The total acreage planted to this crop was not large but it was for the most part widely scattered and the returns were generally profitable.

178. In Western Oklahoma, the returns from planting the Spanish peanut have been care-

fully investigated by George Bishop and the information gathered up to the fall of 1911 has been reported by him as follows:

"My attention was attracted to the hardiness of the Spanish peanut when I found a farmer in Western Oklahoma who had been growing them for several years. The first year I visited his farm was in 1909, and he had planted ten acres of peanuts and ninety acres of corn. This turned out to be the first of the recent series of dry years. The corn was planted in April and the peanuts on May 10. The unfavorable crop season cut the corn yield to thirteen bushels per acre, while the peanuts yielded forty bushels per acre. In 1910, the difference was even greater, though neither the corn nor the peanuts made as much as the year before. Again in 1911, when the corn was an entire failure, the peanuts endured the heat and winds until the rains came in July, then went on and made a yield of twenty-five bushels per acre.

"Another field in the same locality was planted in alternate rows of corn and peanuts. This was done for the special benefit of the corn and not for the peanuts. The intention was to give the corn a wider feeding area for its roots at maturing time, due to the later planting of the peanut. The peanuts, being planted six or eight weeks later, would not naturally use their share of the moisture. This corn field remained green several weeks longer than fields adjoining, planted in the regular

way. The corn, though using the peanuts' moisture for several weeks, was compelled to give up before rains came July 19. The peanuts went on and finally made a yield of fifteen bushels per acre. This was undoubtedly as severe a test as could be asked for."

179. As to planting peanuts, Mr. Bishop says: "The peanut is usually planted about or a little later than cotton planting time where cotton is grown. For Western Oklahoma and the Texas Panhandle, the time for planting would be from the tenth of May on through June. I have records for 1911 in latitude thirty-five of plantings, one on the tenth and another on the fifteenth of July, each making and maturing good yields before frost. The peanut is inclined to be a little slow in its early growth. For this reason, the ground should always be warmed up and well prepared before the seed is planted. They will do better in a shallow lister furrow. This gives them the protection afforded by the furrow and the needed warmth of the surface soil. If a regular peanut planter is used, it is better to make the opening furrow as small as the peanut will drop into easily. The planter running in the bottom of the lister furrow makes this opening in the firm, moist soil; the peanut dropping into it has the benefit of submoisture from three sides and a stand is almost certain, rain or shine. The Eastern farmer drops the seed in loose, moist soil and the rains

come and germinate it, but the dry farmer of the West must place the seed in positive contact with the sub-moisture, so that he will get a stand, whether it rains in one week or three.

180. "The early cultivation of the peanut is practically the same as for cotton. If the land is weedy or crabgrassy, nothing will do quite as good work as a fourteen tooth harrow cultivator. They have a lever adjustment and can be set for the width of the lister furrow. Remove the front and back teeth and go right down the row, cultivating each side. If a little loose dirt is thrown on the peanut plants, no harm will be done. If a heavy rain forms a crust on the peanuts before they come up, the front and back teeth of this same harrow may be adjusted so as to break the crust immediately over the peanuts while the outside teeth serve as runners to prevent them from going too deep."

181. A bushel of Spanish peanuts to the acre will put one pod each twelve to fourteen inches in rows forty-two inches apart. Concerning preparation of seed for planting, H. M. Wolverton of Stephens county, Central Oklahoma, says: "The peanuts can be soaked twenty-four to thirty-six hours just before planting. If the moles and gophers are bad in your soil, dissolve a five cent bar of common laundry soap in a gallon of boiling water and as soon as all has dissolved, add one pint of kerosene and stir for

ten minutes. Mix this in a barrel with enough cold water to soak two bushels of peanuts and the moles and gophers will not eat them."

182. Hilling up is not necessary nor desirable, according to Mr. Wolverton. He says: "The plant, as soon as it has a few leaves on it, begins to bloom and the blooms follow the growth and continually run the little pegs down until frost. I have tried hilling with a hoe and plow, also cultivating level, and I can tell very little difference, if any, in the yield. If hay is desired, cultivate level all through the season, and when the vines begin turning yellow, they are ripe and should either be mowed or dug for hay and peanuts. If they are to be hogged off, the hogs can be turned in after mowing." Clean, shallow cultivation, preventing the formation of a crust on the soil, should be continued through the season.

183. Peanuts are harvested in a variety of ways. George Bishop, in the report previously referred to, says: "Most of the peanuts which have been grown in the West so far have been harvested by hogs and for the present, this is undoubtedly the best plan. In a few places, however, peanuts are grown for market. The peanuts are loosened up by running the share of a turning plow with the moldboard removed, just deep enough to cut below the peanuts. The vines and nuts are then raked into windrows with a hay rake, and in a day or two, depending

upon how quickly they cure, they are put into stacks convenient for threshing. The peanuts are then threshed with a special peanut thresher and the hay is saved for feed. The practice of mowing the hay and turning in the hogs to harvest the peanuts is the one which appeals to me as the plan for the beginner. It was at first thought that the vines were necessary for the cheapest gains, as hogs eat more or less of them. But recent tests have shown that hogs will make practically the same gains when fed on peanuts alone and when turned on a field from which the vines have not been removed."

184. Feeding to hogs is recommended by the Arkansas Experiment Station as the best method of disposing of peanuts. A recent publication of that station says: "This method saves the expense of pulling and hauling, and if portable fences are used so that the hogs can graze over but a small area at a time, the waste of peanuts will be greatly reduced. It is generally considered that an acre of Spanish peanuts will furnish grazing for eight or ten hogs, weighing in the neighborhood of two hundred pounds, for about thirty days. However, this depends upon the yields, size of the hogs, and the quantity of other feeds fed in addition to the peanuts. For the best results, it is advisable to feed corn in addition to the peanuts. By so doing, not only will greater gains be secured, but a much better quality of pork will be produced than if the

peanuts are fed alone. If corn is quite high in price, it might be more economical to produce the bulk of the gains on peanuts alone and simply finish the hogs off on corn during the last three weeks of the fattening period. When fattened on peanuts alone, a soft, oily pork is produced which does not generally find high favor upon the market." Ground kafircorn or milomaize may of course be fed instead of corn to hogs being fattened on peanuts.

185. Peanuts furnish rich feed for cattle and other farm stock, as well as for hogs. The whole peanut plant, vines and nuts, contains 18.4 percent. protein, 40.1 percent. carbohydrates, and 21.5 percent. fat. Peanut hay, from which the peanuts have been removed, contains 10.0 percent. protein, 42.0 percent. carbohydrates, and 3.6 percent. fat. For purposes of direct comparison, wheat bran contains 15.4 percent. protein, 60.4 percent. carbohydrates, and 4.0 percent. fat. Alfalfa hay contains 15.4 percent. protein, 65.8 percent. carbohydrates, and 1.4 percent. fat. Peanut hay may be used very profitably in feeding all classes of cattle, the methods being similar to those followed in feeding alfalfa and cowpea hay. (152, 172.) The ration should be balanced by feeding ground kafircorn or milomaize whenever peanut hay is being fed.

186. Markets for peanuts are certain to be developed as production increases. The yields

run from forty to one hundred bushels per acre and sometimes higher. Aside from the supply required to take care of the demand for roasted and salted peanuts, the manufacture of peanut oil and peanut butter is increasing. Both are being used more extensively as human food. Peanut cake, from which the oil has been pressed, is a rich feed for livestock, containing 47.6 percent. protein, 28.8 percent. carbohydrates, and 8.0 percent. fat. The ease and profit with which peanuts may be disposed of by feeding to livestock, if the market is unsatisfactory, and the fact that, like alfalfa and cowpeas, peanuts obtain from the air a portion of the nitrogen required for their growth, make this one of the sure feed crops to which increasing acreages should be planted in the Central Southwest.

SORGHUM

187. Sweet sorghum or cane, as it is commonly called, is one of the surest of feed crops. The season has not yet been so dry in Oklahoma that sorghum, planted at some time between April 1st and July 15th, has not produced a fair yield of rough feed. Unless abundant rough feed is assured from kafircorn fodder, alfalfa, cowpeas, and peanuts, a reasonable acreage of sorghum should be included in every season's planting.

188. "Hard on the land" is an indictment

most frequently brought against sorghum. The ability of the crop to withstand extremes of drouth and still produce feed naturally carries with it the effect of drying the soil thoroughly and filling the surface soil with a mass of fibrous roots which decay very slowly if undisturbed. An ordinary crop of sorghum, amounting to from two to seven tons of cured sorghum hay per acre, also unquestionably draws heavily upon the supply of available plant food in the soil. The thorough drying of the soil by this crop and the failure to break up the land in the late fall or early winter in preparation for succeeding crops is responsible for short yields of other crops following sorghum. This may in very large measure be overcome by following the same methods of soil preparation as have been suggested for kafircorn and milomaize. (12.)

189. Rich land is needed for the production of heavy crops of sorghum hay, and it pays well to use the stable manure on land on which sorghum is to be grown. Thin, shallow upland soils should not be expected to produce profitable crops of sorghum hay without heavy manuring. The average soils of the Central Southwest will, however, produce heavy yields of sorghum hay in average seasons and fair yields in seasons of extreme drouth.

190. For hay, sorghum may either be broadcasted or put in with a grain drill, using about

one bushel of seed to the acre. The land should be plowed and harrowed, and the better the preparation in advance of the time of sowing, the more certain the yields under unfavorable conditions. The sowing may be done at almost any time from April until July, thus making it possible to work this crop in as a catch crop, and occasionally to sow it on a portion of the wheat and oats stubble if chinch bugs are not sufficiently numerous to interfere. For the best quality of hay, sorghum should be cut just as it is heading out. When cut at this stage, the food materials which later are concentrated in the seed are uniformly distributed throughout the plant and the stems have not become woody. The general custom is to cure sorghum hay in large piles, after having permitted the crop to wilt and partially dry in the swath and windrow. Often these piles remain in the field until fed, but there is naturally much waste as a result of this method. A better plan is to stack the hay in large stacks after it has well cured and to be particular about topping out the stacks so that they will not take water. A few farmers in the Central Southwest have adopted the custom of always having a few stacks of sorghum hay left over in the spring so as to make absolutely sure of an abundance of rough feed for all of the farm livestock whenever an exceedingly dry season comes along.

191. For seed sorghum is planted and culti-

vated in the same manner as kafircorn and milo-maize. (12.) The varieties most commonly grown are Black Amber, Orange, and Sumac. It is well to make a contract with some dealer in seeds before planting a large acreage to sorghum for seed purposes. The market for sorghum seed is confined to the demand for planting purposes and in seasons of heavy production the price is very low.

192. Pasturing sorghum with cattle is attended with some danger. When the crop is stunted in growth either by drouth or frost, Prussic acid, which is the poisonous principle of potassium cyanide, develops and cattle eating of such sorghum die very quickly. Losses from this cause do not appear to be so frequent in Oklahoma and Texas as in Kansas and Nebraska, and many cattlemen regularly utilize sorghum for pasture, especially for animals necessarily confined to small lots. Hungry cattle turned into a field of succulent sorghum are also very susceptible to bloat and precautions are necessary until the cattle become accustomed to the sorghum pasture.

193. The widest use of sorghum as a pasture crop is for hogs, though it produces but small gains, and is valuable chiefly for its succulence. It produces an abundance of forage during dry, hot weather, when other crops make but little growth. Usually it is ready to pasture within six weeks after sowing and the hogs should not

be turned in until the growth is at least one and one-half feet high. About one acre of pasture should be provided for each twelve to fifteen head of 100-pound hogs and a supplementary ration of grain is necessary if the hogs are to be expected to make much growth. Losses of hogs pasturing on sorghum, due to sorghum poisoning, are very rare.

194. The feeding value of sorghum hay is very similar to that of corn fodder and kafircorn and milomaize fodders from which the heads have been removed. It may profitably be substituted for prairie hay in the feeding of horses and may form a very large share of the ration of stock cattle receiving a light feed of cottonseed meal or cottonseed cake. Steers may be wintered very economically and satisfactorily on nothing but sorghum hay and two pounds of cottonseed cake per day per head. Sorghum hay cannot replace alfalfa, cowpea, or peanut hay in either cattle or steer feeding, but it may be used as a supplementary feed from which the cattle may eat their fill after having had a properly balanced ration of ground kafircorn or milomaize and cottonseed meal or ground kafircorn or milomaize and limited amounts of alfalfa, cowpea, or peanut hay. In seasons of extremely high prices of grain, stock may be wintered fairly well with no other feed than sorghum hay, and an abundance of it on hand at all times will bring greater profits to

stockmen than can be had from depending upon the pasture furnished by stalk fields.

195. Very sandy soils may be quickly improved in texture by growing on them and plowing under a crop of sorghum just as it is heading out. No other crop will so quickly furnish a large amount of vegetable matter which, when decayed, becomes incorporated with the particles of sand and causes them to stick together more closely, thus improving the ability of the soil to hold moisture. The growing of sorghum on the land and plowing it under adds nothing to the supply of plant food in the soil, but if turned under in July and the land is not planted to a crop until spring, beneficial results almost invariably follow if the soil is very sandy.

196. Sorghum smut sometimes interferes with the production of satisfactory sorghum seed. This may be prevented by the same treatment recommended for the seed of kafircorn. (32.)

MILLET

197. German millet is the variety commonly grown. Two pecks of seed per acre are broadcasted or drilled on land previously plowed and harrowed. To insure a crop in seasons of short rainfall, millet should be sown in May or early June; in seasons with ample July rainfall, it may be sown as late as the middle of that month. Millet is largely used as a catch crop,

in much the same manner as cowpeas, and for that reason, the acreage is variable.

198. Texas millet, or Colorado grass, is a common weed in portions of Texas and has been reported from a few localities in Oklahoma. Though possessing the habits of a weed, it is useful as a hay crop. Like all millets, this is an annual, but the seed shatters and remains in the soil until the following season. It makes but little growth early in the season and does not interfere with the growth of cultivated crops. After corn, for example, has matured, this variety of millet makes a good growth which may be cut for hay.

199. Millet hay should be cut while in bloom and before the seed have begun maturing. If mature seed is in the hay, not only do the stems become woody so that they are not eaten well by stock but the seed has an injurious effect on the kidneys of the animals which eat it. If cut while in bloom, millet hay may be fed to horses and cattle and has about the same feeding value as good prairie hay. With diminishing acreages of native meadows, it is probable that millet will be more extensively grown. But the production of large amounts of kafircorn fodder and sorghum hay may make the growing of millet entirely unnecessary unless the individual has a special preference for it.

SILAGE

200. Succulent feed at all times, if it can be provided, is of great value in maintaining a regular flow of milk from dairy cattle and in keeping stock cattle in thrifty, growing condition. Decreasing acreages of native pasture, short wheat pasture through several winters, and drouthy seasons have combined to interest the farmers of the Central Southwest in silos as a means of storing succulent feed for their cattle. They are seeking some regular plan of storing feed which will not fail in seasons of extreme drouth, and which will be profitable in normal seasons. Prior to 1909, relatively few farmers in Kansas, Oklahoma, and Texas had built silos, though their use has been quite general in the Central States for many years. Since then, large numbers of silos have been erected in Kansas, Oklahoma, and the Texas Panhandle.

201. It will pay the farmer who has, or can get, twenty or more cattle to feed throughout the year, to build a silo and regularly grow a crop with which to fill it. But it is exceedingly doubtful if it will pay anyone to erect a silo for the purpose of storing sun-scorched corn fodder in the occasional years when drouth prevents the formation of ears. The man who buys a silo intending to use it every month in the year as a means of storing succulent feed for cattle is on

the right track; if he has the cattle or can get them. The silo should be an integral part of the livestock equipment to be used every year; not a temporary expedient for use only in dry years.

202. The silo is a big can, air-tight except at the top, in which green fodder of any sort, with solid stems, may be preserved in much the same manner as fruits and vegetables are canned and preserved for human food. The process is different but the result is essentially the same. The fodder, cut into short lengths, not over an inch long, and firmly tramped in the silo, settles and undergoes a fermentation which develops heat and drives out the air and sterilizes the product so that no further fermentation can take place until more air is admitted. The cut fodder at the top of the silo decays more completely and forms a covering which prevents the air from penetrating to a depth of more than one to two feet. Silage is canned, green fodder.

203. Many types of silos are in use. The Kansas Experiment Station at Manhattan and the Oklahoma Experiment Station at Stillwater have published bulletins describing different types. Manufacturers of Portland cement have prepared plans and specifications for building concrete silos which may be obtained from almost any dealer in Portland cement. Vitrified hollow tile, properly curved for cylindrical silo construction, are coming into extensive use in

Iowa. Cylindrical stave silos are manufactured by several firms who advertise in the farm papers. Numerous manufacturers are selling silos built of sections of galvanized iron with interlocking joints, painted inside with a coating of gas tar to prevent corrosion by the acids of the silage. Some silos are built partially above and partially below the ground and a few are repeating the original plan of building silos like cisterns, which has long ago been discarded where silos are in general use. The requirements of use should be kept in mind when deciding upon a type of silo to build. It must be air-tight except at the top; must not dry out during very dry spells and permit evaporation of moisture through the walls; must not blow down easily or require close attention to keep in safe condition, either when full or empty; and must be so placed and constructed that the silage may be fed out with the minimum amount of labor. It should also be durable and require the minimum of annual repairs and attention.

204. The size of the silo should be such that not less than two inches of silage is fed from the surface each day and it is better if four to six inches are fed daily. The higher the silo, within reasonable limits, the better the silage settles and keeps. A silo fifteen feet in diameter by twenty-nine feet high will hold one hundred and ten tons. It will take about seven to ten acres of average corn or kafircorn to fill this

and it will provide forty pounds per day per head for twenty-six cattle for six months. If double this amount of feed is wanted, two silos will be better than a single silo of double this capacity.

205. Crops for silage should be regularly planted for that purpose. Corn is the earliest crop which may be grown for filling the silo. It should be planted as early as is safe for the locality, in the same manner as if the corn was being grown for the grain alone. An early variety is best, so that it may be matured, if possible, before the dry summer weather which so frequently reduces the yields. If drouth prevents the formation of ears, the fodder should be cut and put in the silo before the leaves have died. If conditions are favorable, the corn should be allowed to nearly mature, having passed the roasting ear stage before being put in the silo. In all of the Central Southwest, there should be planted each year a sufficient acreage of kafircorn to fill the silos. It should be planted at the earliest date which experience in the locality has shown to give the highest average yields of grain. There will then be no question about something with which to fill the silo being produced. Sorghum and milomaize may also be put in the silo but they are not as satisfactory as kafircorn and corn.

206. Filling the silo requires considerable labor, but for only a short time. The kafircorn

or corn may be cut with a corn binder or sled cutters. It should be placed on low wagons and at once hauled to the silo where a power cutter is arranged to cut the fodder into pieces not more than an inch long and blow it into the silo. From three to five farmers might well join in ownership of the power and cutter and help each other in the work of filling. Men with threshing outfits might also make silo-filling part of their business. The cut fodder should be evenly distributed and well tramped, the middle being kept full and the tramping being heaviest around the walls. If the silo is of wood or concrete, the walls should be thoroughly wet down with water before filling begins. If the silo is of galvanized iron, it should be thoroughly cleaned inside and painted with gas tar a few weeks before filling. Unless the fodder has dried up beyond the proper stage for putting in the silo, it is not necessary to add water as the silo is being filled. But if the fodder is dry, wetting down with water will help put it in condition to settle and keep well. Do not put salt on the silage.

207. Sealing the silo after it is filled is accomplished by thoroughly wetting down the top two feet of cut fodder, then covering it with a foot or two of chaff or short straw and wetting this thoroughly, then letting it alone and not walking around over it to "see if it's keeping all right." Fermentation will soon begin and this will drive some of the moisture up through

the wet layer on top. This will partially decay and effectually seal the top. A roof on a silo adds to its appearance but is not necessary.

208. Corn silage put up in July may be used to supplement the pastures. Feeding may begin as soon as filling is completed. The succulence of silage adds greatly to its feeding value but its real value as feed depends upon the amount of grain which it contains. Cattle of all sorts fed silage may be expected to do about as well as if they had an abundance of grass pasture. After part or all of the corn silage has been fed out, the kafircorn which should always be planted for this purpose may be put into the silo at any time before frost. The fact that the stalks and leaves of kafircorn remain green for a long time after the grain has matured makes the period during which the crop may be put into the silo longer than with corn. The cut kafircorn should be put in right on top of the corn silage and, if not to be fed at once, sealed after filling is completed. The spoiled silage at the top should be removed when feeding begins and the silage should be taken from the entire area of the top at least once every two days.

209. Silage is rough feed and should not be expected to take the place of grain in the ration. While it is possible for cattle to make fair gains when fed silage made from kafircorn or corn containing a full crop of grain, the amount of

grain supplied by the silage is not enough for the best returns. Steers were fattened in Oklahoma during the winter of 1911-1912 on nothing but silage and cottonseed cake and the high prices of kafircorn and corn made this the most practicable ration. A ration of silage and one to two pounds of cottonseed meal or cake per day per head will carry stock cattle through the winter in excellent condition and maintain them in fine shape to begin feeding. Alfalfa, cowpea, or peanut hay may take the place of cottonseed meal for such purposes, but some feed rich in protein should always be supplied when silage is being fed. Silage supplements alfalfa hay and each adds to the value of the other in general feeding.

210. For fattening steers, silage is coming into increasingly extensive use. The stockman who makes steer feeding a part of his farm operations, and many more of them should do so, will find a silo a valuable investment. The grain ration should consist of four to five parts of ground kafircorn, milomaize, or corn mixed with one part of cottonseed meal, fed in such gradually increasing amounts as the cattle eat up clean without going "off feed". From twenty-five to thirty-five pounds of silage should be fed per day per head and the ration will be improved if a few pounds of alfalfa, cowpea, or peanut hay are fed. Variety in the ration, if properly balanced, quickly shows its benefits in increased rapidity of gains and better finish of

the cattle. It is a mistake to expect that silage alone will supply a satisfactory feed for fattening steers. But many experiments have shown that when properly fed as rough feed, supplementing a balanced ration of grain, silage is of much greater value than the fodder from a like acreage of kafircorn or corn prepared for feeding in any other manner.

211. Silage has long been used as feed for dairy cattle and it is only in recent years that it has been extensively used in steer feeding. The succulence of silage is a great factor in maintaining the flow of milk. But as in steer feeding, heavy production should not be expected from feeding nothing but silage to dairy cows. They should be fed ground kafircorn, milomaize, or corn mixed with about one-fourth as much cottonseed meal, or one of these grains and alfalfa, cowpea, or peanut hay in addition to a liberal ration of silage. The amount of silage fed will depend upon the ability of individual cows to consume it profitably and will vary from thirty to fifty pounds per day per head. The amount of grain fed should vary with the milk production of the different cows, this being a measure of their ability to turn feed into milk at a profit. A dairyman with ten or more cows can scarcely afford to be without a silo in regions of short rainfall where pastures quickly dry up and periods of excessively high prices for feed are not infrequent.

212. Cash value of silage. One great point in favor of silage is that it is not marketable. It can be sold only for feeding at the silo, thus keeping elements of fertility which it contains on the farm which produced it. Perhaps $2.50 per ton may be taken as a fair average cash value of silage. Fed to good steers or to dairy cattle, it will turn out more than this, just as under average conditions, kafircorn, milomaize, or corn when fed bring returns above their market value. The silo does not offer an easy way to prosperity to men inexperienced in the feeding of livestock. But it does furnish a means whereby the careful stockman may establish his business on a firmer foundation than when he depends upon dry feed alone.

213. Hogs will eat silage and steers being fattened should always be followed by hogs. Silage should not be expected to do more than replace pasture in hog feeding.

214. Idle horses may be fed some silage to advantage but silage in any considerable amounts is not good feed for working horses. Horses fed silage should also receive hay. Silage can fill many places profitably in the farms of the Central Southwest but its extensive use in horse feeding is not one of them.

THE PASTURE

215. Grass is first in importance to stockmen. Producing heavy yields on fertile lands, covering rough, untillable lands and causing them to be productive, grass requires no labor in the harvest and the returns in the way of added weight of the livestock pastured upon it are practically net. The constant desire of the stockman is for nutritious grasses on which his flocks and herds may graze, taking on cheap growth and gains in weight without impoverishing the soil, but often adding to its productivity.

216. Grasses adapt themselves in but small degree to new and unfavorable environment. Each variety and kind finds its best development under conditions of soil and climate fitted to its habit of growth and responds but feebly to attempts to establish it where the conditions requisite to its natural growth do not exist. A compelling sentiment seems to drive settlers on new lands to attempts to establish there the grasses of the pasture and meadow on the old home farm. The lawn about the new home must be sodded with the grass which carpeted the soil under the trees about the old homestead, or it will not seem like home.

217. Native grasses of the prairie, with but few exceptions, soon disappear under the close occupancy of farm stock. Sloping soils under clean cultivation soon develop into gullies and the sand and silt are carried down and spread over the fertile bottom lands below. Weeds take the place of nutritious grasses in the pastures and the feeding of livestock through the summers becomes an increasingly difficult problem. Many of the grass problems of the states of Kansas, Oklahoma, and Texas are still unsolved.

BERMUDA GRASS

218. In 1892, immediately after the Oklahoma Agricultural Experiment Station was established, one of the first things done was the sowing of the seed of more than two hundred varieties of grasses gathered from all parts of the world. While at that time, there was an abundance of native grasses, it was recognized that in all probability the grass question would still be unanswered when it came to be of pressing importance. Seed of the most promising grasses selected from these, and others as they were obtained, were sown every year thereafter, and such kinds as are best propagated from rootstocks were transplanted and carefully tended.

219. Fourteen years' results from this work were summed up by the writer, in Bulletin 70

of the Oklahoma station, issued in June, 1906, as follows:

"When once established, hardy bermuda grass is not easily killed out. There need be no fear of its 'taking the country' and becoming a pest this far north. The only complaint here is that, after having been growing on the station farm for fourteen years, it has 'taken' so little of it. But bermuda grass does not work well in a rotation. Its place is for permanent pasture, for hay on good land subject to overflow, and for a solid covering for the lawn and the usual muddy spots about the house and feed lots. The station has it growing and giving a profitable yield of pasture on land so full of white alkali that no other crop will grow. In spots, it has been under water for three weeks and kept on growing, thus showing its adaptability to overflow lands. Eighteen inches of tough clay have been tamped down on an established sod of bermuda grass and in six weeks, the grass made its way through and formed a sod on top. Strips of bermuda sod have been placed four feet apart across gullies by the roadside, and within two years, it was necessary to plow out the gutter to furnish a place for the water to run. Ditches in cultivated fields, so deep as to be impassable for farm machinery, have been filled in one season by the dirt caught by bermuda grass planted in the hard soil in the bottom of the ditch. New pond banks have been sodded over

in one season with a tough mat of bermuda which absolutely prevents washing.

"After ten years of futile attempts to make the college campus presentable by sowing seed of Kentucky blue grass, orchard grass, meadow fescue, all the clovers, and a great variety of mixtures of seed of other grasses, bermuda grass has in three seasons covered it with a heavy sod which is green from April to October when grass ought to be green. And during the winter, there is a clean covering over the whole surface, without mud when it rains or dust when it blows.

"Sometime, a more satisfactory grass than hardy bermuda grass may be developed in Oklahoma. But after having repeatedly sown every grass that could be found, through fourteen seasons in Oklahoma, the station has only this variety of bermuda grass to show for the work. It is satisfactory in every respect in this locality and trials which have been made of it elsewhere in the Territory indicate its future usefulness over the entire area. In the northwestern fourth of Oklahoma, and along the northern boundary, it may not be entirely satisfactory, but there is every reason to expect it to provide profitable pasturage under suitable treatment even there."

220. Bermuda grass is probably a native of India. It was introduced into Georgia in 1812 and from there soon spread to the other southern states. It is the one pasture grass of out-

standing value for the south, just as Kentucky blue grass is the standard pasture in regions naturally adapted to its growth. But the production of cotton and not of livestock was for so long the chief industry of the southern states, and since the habit of growth of bermuda grass caused it to persist in the cotton fields, it was long regarded as a pest instead of a benefactor. In Oklahoma, the northerner has wanted grass and many have spent years in vain endeavor to establish Kentucky blue grass, refusing to accept bermuda, the one grass which will persist and furnish pasture. The southerner, recollecting the days spent in hoeing out bermuda grass in the cotton fields, will have none of it and refuses to accept the gift which Nature has offered. These transplanted sentiments and prejudices are slowly being overcome and bermuda grass is coming to be recognized as the only pasture grass for the greater portion of Oklahoma.

221. Hardy bermuda grass is merely bermuda grass which has grown in a given locality until it has become acclimated through natural selection and possesses increased ability over the original stock to withstand extremely low temperatures. Bermuda grass grown from seed is almost always severely damaged by very cold weather and often only a few plants survive. These in time spread and cover the ground. A still colder winter will kill many of the plants, but these, in turn, will occupy the land. The

bermuda grass which survives these unfavorable conditions starts into growth earlier in the spring than the original stock, is not killed by hard freezes, and is called hardy because of these qualities.

222. Bermuda grass has limits on the north and west beyond which it is not profitable as a pasture grass. Bulletin 175 of the Kansas Experiment Station, says: "At this station, it usually winter-kills, but in the southern counties of the state it is comparatively hardy, and farmers there have reported that they have grown it successfully for periods of from four to eight years." Bermuda grass has not proven entirely satisfactory in the northern half of Oklahoma west of the ninety-eighth meridian. Its limits of profitable growth in western Texas have not been defined, though probably they will closely correspond with the limits of profitable cotton culture.

223. Starting bermuda grass from seed is not satisfactory. It should always be propagated from sod of the grass which has become acclimated to conditions. Many years of natural selection may thus be made to contribute to the obtaining of a profitable pasture at once. The quickest stand will be obtained from planting bermuda roots at favorable times from April to July in well prepared land. If bermuda roots are planted as potatoes are planted, in rows wide enough apart for a cultivation or two, the

pieces of sod being entirely covered, success is almost certain except in seasons of extreme drouth. Methods of planting vary from this very widely. Bermuda may be started by dropping roots in furrows as the land is being plowed shallow; by dropping roots in lister furrows just before the ditches are filled when cultivating crops; by loading the sod in a manure spreader and scattering the roots over roughly plowed land, disking them in; by dropping roots on the surface of the soil during wet spells and forcing them into the soil with a forked stick; or by any other plan which will bring either the runners or underground stems of bermuda grass in contact with moist soil which is warm enough to stimulate growth. Tearing the sods to pieces and stringing the underground stems and runners in a furrow where they may be completely covered is more likely to produce a satisfactory sod quickly than carefully setting out small pieces of sod or small bunches of roots with the tops exposed. In selecting sod for planting, that which shows evidence of most vigor and which starts into growth earliest in the spring should be chosen.

224. Results of experience with bermuda grass in Oklahoma have been reported in great numbers, the writer having collected them during a period of fifteen years. They represent wide variations due to the time and manner of planting, and the character of the soil and climate and treatment. It is thought that a few

of them, collected in the spring of 1911, will give a clearer idea of what to expect than can be obtained from an extended discussion.

225. Texas County, Western Oklahoma. "In May, 1908, we planted five sacks of bermuda roots as you would plant potatoes. The season was dry but the grass nearly covered the ground. It winter-killed badly, but we plowed it up and scattered the live roots and the grass covered the land in mid-winter in 1909. It was a very dry year and the runners died, leaving only the main bunch. It winter-killed back to about half a stand but I thought it would succeed and broke more land by the side of the strip where we had bermuda planted. We scattered the sods in the spring of 1910 and it covered the ground by mid-summer. Now, we do not have a spear of bermuda left, and I am convinced that at this altitude and with our extremely dry climate, bermuda is a failure."

226. Beaver County, Western Oklahoma. "In the spring of 1905, I received a package of bermuda roots sent to me by mail from Hill county, Texas. In the spring of 1908 I planted one-quarter acre with roots; in the spring of 1909 I planted three-quarters of an acre, making one acre in all. In the spring of 1910 I thought it was all killed and I plowed a part of the land and planted it in watermelons. The grass began to come out and I did not make many melons on it. This spring it was all killed out

again and I broke a part of the sod and double disked it and drilled the land in cane. I intended to plant out several acres of the roots in 1910, but it was killed out so I could not get the roots to plant. I thought after it came out so in 1910 that I would plant quite a lot this spring but it killed out worse than it was last year; so I have decided that bermuda grass is a failure and will not do to depend on in Beaver county for pasture. I have not got any better prospect for pasture and not as regular stand as I had two or three years ago. It kills out so in winter that the weeds take it unless I plow it in spring and then it takes all summer to get ready to pasture. I see some say that the drouth killed their grass. My bermuda has stood the dry weather as well as my alfalfa, but it is the freezes that killed mine. It takes it too long in spring to get started to depend on it for pasture here."

227. **Alfalfa County, Western Oklahoma.** "Several years ago I received some roots from the Experiment Station and they have done very well. Last winter was very hard on it and, in fact, I thought it dead, but by the 15th of April it had started out nicely and at present is looking fine."

228. **Alfalfa County, Western Oklahoma.** "Planted an acre of bermuda in April, 1910, securing the roots from a neighbor. Only about a half stand came up on account of drouth. Part

of the land was alkali and part sandy. It sodded over the alkali ground within ninety days after planting, but did not spread much on the sandy land. A dozen hogs ran on it after it got started and plenty of growth was left for winter protection on the alkali land. It is now apparently dead on the sandy land but about half of it is started on alkali spots."

229. Grant County, Western Oklahoma. "I secured a few roots from the Experiment Station at Stillwater on June 11, 1906, and have worked earnestly to get my washy hillsides to bermuda ever since, but have failed. I have ten acres of hillside with clay subsoil that I have put in bermuda three successive years and had it to die on account of drouth and cold winters each time. Had intended to try it again this spring but find my first patch that has been planted five years so badly killed out that I have given it up. I have been enthusiastic about bermuda all along and have caused much of it to be planted around here, furnishing the roots free, but last winter has pretty nearly settled it in this neighborhood. I have not pastured it any, as it did not get far enough along except the first planting which I kept for getting roots from."

230. Custer County, Western Oklahoma. "I planted about nine sacks of roots last year; put them out in May on about two acres of land. We had good rains shortly after and the grass

came up and grew fine right through the dry weather in the summer. We had one good rain in August, which started it growing again and by October the ground was almost covered. I felt good to think that I had a start of bermuda at last, but some of my friends told me that it would die out when winter came. One of them told me that he had been trying it for several years and it always winter-killed. Another has had the same experience. Bermuda is all right where it will grow, but it will never do in the northwestern part of the state."

231. Custer County, Western Oklahoma. "I have known bermuda grass for fifteen years. In the southern states it has taken many a valuable piece of land and entirely ruined it for farming purposes, but produced a wonderful lot of hay and pasture. There is plenty of better feed than bermuda hay but for pasture there is nothing in the southern states that excels it. It comes early in spring and stays until frost and it doesn't matter much whether it rains or not, it stays green. In this part of Oklahoma no man need be afraid of bermuda taking his land. The worst trouble we have here is to keep it. It gets so cold here it freezes out. I planted my lawn and barnyard last of May, 1910, and as dry as it was, nobody had a finer lot of grass than I had, unless it was bermuda. But the cold and dry winter killed much of it. If all the washed off hillsides were in bermuda, we certainly would have pasture that would be worth

two to one of what we have got. So plant bermuda for pasture and turn out your stock on it, and save time and labor of sticking up signs, 'keep off the grass'."

232. Washita County, Western Oklahoma. "After a careful examination, I find that about half of my bermuda grass is dead. It was planted five years ago; part of the roots obtained from the Experiment Station and part from seed from the United States Department of Agriculture. There is no difference in them. Both died out alike. None of it has been pastured during the past twelve months."

233. Kiowa County, Western Oklahoma. "I started with a few roots sent me from the Experiment Station five years ago and planted them in my yard on freshly broken sod, getting a fair stand and covering the ground in two years. The second year being a very wet one, it did reasonably well but, except that season, it was almost a failure, freezing back very badly each year. It is almost all frozen out now except some few sprigs just showing up. I am taking care of it; fertilized the ground and replowed it. All of the grass which has been planted since is in better shape than that in the yard. I have no bermuda grass that I consider good, but I have neither tended it well nor given it a fair piece of ground. Hogs certainly like bermuda grass roots, as they are fresh and sappy when the alfalfa is dead."

234. **Blaine County, Central Oklahoma.** "Very little of our bermuda died either from dry weather or freezing. Probably not over five percent. of it is damaged. This is the big variety of bermuda which you sent us from the Experiment Station several years ago. The small variety which we got at Kingfisher, and which has stood for eight or nine years here, is damaged from sixty to seventy-five percent. but it is starting nicely and bids fair to reset the tract."

235. **Garfield County, Central Oklahoma.** "I have patiently waited for warm weather but am compelled now to state that my bermuda is nearly all dead on the half acre which I planted three years ago and cared for well, never pasturing it closely or late. It is now about one-third of a stand which will thicken up to a sod again. That which I planted last year and the year before is all dead."

236. **Canadian County, Central Oklahoma.** "My bermuda grass is alive but have been holding my opinion as long as possible for fear of accident. There are more dead roots in it than common, but there are always some. Where not pastured into the ground, it is fine grazing now. It is at least twenty days late this year. On the poorest high places where pastured hard, it is coming but from the deep roots."

237. **Canadian County, Central Oklahoma.** "My bermuda planted last June on well pre-

pared ground and kept clean made a nice growth and completely covered the ground. Six or seven roots only have started growth this spring. Neighbors' pieces likewise are all dead, but it came from the same stock. Alfalfa seeded last spring makes a pretty fair show and the old patch is doing well. It looks as though it can stand more than bermuda."

238. Oklahoma County, Central Oklahoma. "Genuine, hardy bermuda grass is in good condition on my farm and it was pastured to the roots last year. It was set out in July, 1908, on sandy soil. Other kinds of bermuda are dead or badly hurt. A few warm days may change their condition. I firmly believe that the genuine, hardy bermuda grass will hold its own under the most trying of circumstances."

239. Pottawatomie County, Central Oklahoma. "In 1910 I set bermuda in the hog lot and some just outside where the cattle and horses ate on it, tramped on it, and wallowed in it. I thought this would surely die, but instead it is green and nice at this time. That in the hog lot made good growth, but it is nearly all dead now,—just a few green sprigs are showing. Some little patches in the pasture, which had been sodded over for four or five years, are dead but this does not discourage me. I have set out some more this spring and intend to plant still more if nothing prevents it."

240. Lincoln County, Central Oklahoma. "I was compelled to pasture my bermuda very heavily during the drouth last summer and was afraid that it was dead. It is coming out since the spring rains, and if we ever get any warm weather it will be all right. If the day ever comes when every acre of land in Lincoln county that will grow alfalfa is seeded to alfalfa and all the rest of the land is set to bermuda, we will have made a move in the right direction."

241. Lincoln County, Central Oklahoma. In the spring of 1911, F. A. Mitchell wrote: "We thought ninety-five percent. of our Lincoln county bermuda grass dead but find that percent. now living. Every warm day develops new shoots. We have examined very many fields and have found none entirely dead, only in patches. The unprecedented drouth of last year and the hard sharp freezes of last winter struck a staggering blow to bermuda long set or new set upon sandy or any other soil.

"Some tracts we are now pasturing; others will not be ready until July, while other small tracts we will plow up and reset. We estimate that more bermuda will be set in Lincoln county this year than during the past five years. Farmers have been drawing roots by the wagon load from tracts not damaged. We have already set over forty acres this spring and shall continue in well doing.

"What if ninety-five percent. of the bermuda was dead! We would set the five percent. and try it again. Oats blight and we sow again. Kafir blasts and we plant again. At least one-third of our cotton crop was destroyed last year by the cotton worm and sharp shooters, yet we add twenty-five percent. to the acreage of our cotton this year. Mules die and we raise or buy more. Wives die and men get married again.

"We say bermuda grass for Lincoln county, now and forever, one and inseparable. Let it grow until it shall transform our depleted hillsides into pastures of carpeted green, and our farmers from a mortgage bondage into the full liberty of independent plentitude."

242. Caddo County, Central Oklahoma. "Bermuda is very fine pasture while it is here. Can't be beat. It comes in late and goes out at the first frost. It is hard to get started and at first is expensive. As to bermuda hay, I would as soon have good oat straw. I have five acres, put out last spring, but it was so dry it did not get set good and I am afraid it has not lived through the winter. My neighbor south of me has thirty acres and I know of four others. But they are out on the prairie, not protected by timber, and froze out a year ago. Three of them reset last spring and it was dry and it didn't do so well. However, it may not be dead. We hope not. I fully believe that if we can ever get bermuda four years old, being careful not to

pasture too closely and never burn it off, there will never be danger of it freezing out."

243. Cleveland County, Central Oklahoma. "I have examined my bermuda grass fields, which were planted one, two, and three years ago; some pastured and some not pastured. I have found all of the summer and fall growth dead but the original roots are usually alive and springing, although it will take the entire summer to get it back where it was. I am very sorry about this, as it has shaken my faith a little in the hardiness of this splendid pasture grass. However, the failure was no doubt caused by the drouth."

244. Cleveland County, Central Oklahoma. "I have a piece of bottom land which overflows and I did not know what to do with it. I planted bermuda grass year before last. It is simply fine and hard freezes do not hurt it. But in the orchard, where some of it started some years ago, it is all dead because it was plowed in the fall and the ground was loose. We need not be afraid that it will 'take the country,' but it will keep our stock fat if we let them have plenty of it."

245. Logan County, Central Oklahoma. "Here is the way I plant bermuda grass roots: I use the front wheels of a narrow-tired wagon and the hind wheels of a wide-tired wagon. I put on a set of dump boards and load the wagon

with sods cut about two inches square. I drive the wagon down the furrows previously made by using the two hind shovels of a cultivator set the right distance apart to fit the wagon tracks. A boy or man seated on each side of the wagon drops the sods into the tracks made by the front wheels, and the hind wheels press them down into the soft earth."

246. Oklahoma County, Central Oklahoma. "There seems to be one good feature about the dry winter; it has killed about all the slow-starting bermuda. Now we should set none but the rank, quick-starting, hardy kind. I had five varieties of bermuda last year. I now have just two kinds; both vigorous, early-starting, regardless of soil, location, condition, or protection."

247. Latimer County, Eastern Oklahoma. "In the spring of 1910 I secured from a farmer near McLoud, Oklahoma, ten sacks of bermuda turf. Had prepared a plot of ground, about two and one-half acres next to a public highway, and in April small pieces of turf were dropped in furrows thirty inches apart and covered with a garden hoe. The weeds and bushes (it is new ground, with a few scattering trees left standing), made better growth than the bermuda last season and the dry weather combined to retard it to such an extent that in August, when we cut the bushes and weeds with hoes, a great many bare spots of ground could be seen. The

weather continued dry through the fall and winter and the following spring and summer was so dry that up to August of this year very little bermuda could be seen. After the late rains set in, a thick growth of a kind of wire grass covered the ground and I said 'Goodbye, bermuda'. In September I noticed some suspicious stems of a greener hue protruding above the mat of wild grass and a few days after I made an inspection when, lo and behold, the bermuda was a solid turf over almost the entire field."

248. McIntosh County, Eastern Oklahoma. "Regarding bermuda grass, I wish to report that in this section, that which was set out last year did not get a good start, froze out last winter, excepting the original spots where first planted. These spots were slow in coming out this spring on account of the cold weather and three weeks ago I thought even the original spots were entirely frozen out; but the last ten days of hot weather has started up the grass wonderfully and it is now spreading in good shape. I am now putting in twenty acres all in bermuda for pasture. Besides, I am putting it on each of my places with the intention of having a pasture on each place. The country around Eufaula has less pasture land on account of sc much timber and what is cleared is generally devoted to cotton. I started putting in the twenty acres three years ago and had heard so much about bermuda taking the

country that I loaded a few pieces in the back of my buggy, went out to this twenty acres and stuck a few spots in what I thought was reasonable distance over the twenty acres, confidently expecting from what I had heard that by fall I would have twenty acres of bermuda pasture. This is the third year and I do not believe that any one of these spots is a foot in width and I am now planting it out considerably closer together than I did three years ago."

249. Hughes County, Eastern Oklahoma. "In 1910, we got bermuda roots from the railroad banks and planted around the heads of ditches in field, washed there in 1908. The ground was foul and there was little chance to cultivate, but in some places the grass has a good turf and is doing fine. It is dead in but few places; general condition good."

250. Cherokee County, Eastern Oklahoma. "My own experience with bermuda grass for the last three or four years has brought me to the conclusion that so far as Eastern Oklahoma is concerned, bermuda is a nuisance and should be classed with Johnson grass, now outlawed by the state. About four years ago, I was induced by a well-meaning friend to set my yard and lawn with bermuda grass, and the result—so far as getting a lawn was concerned—was all that could be desired. We soon had a thick, heavy set coat of grass all over the yard. But alas! Through the carelessness of someone, a

few sprigs or joints of bermuda had found their way into the feedyard, from which place the bermuda must have been transferred to the cultivated fields when the manure from those lots was hauled out there. Anyway, the bermuda is there; about that there is no doubt, I can assure you. I have about three acres in strawberries, which is one of the most appreciated spots on the farm, and here the bermuda has been doing its best to rob the family of one of its choice assets, and an income of several hundred dollars per season. Seven different times did we eradicate (?) the bermuda from our strawberry field last spring and summer. And the last cleaning out was so thorough that not a joint of bermuda grass could be seen anywhere, and happy in the thought that at last our bitter and relentless foe had been conquered, we placed the mulch on our strawberry patch and serenely awaited the coming of spring. Last week I noticed the new growth of an extra early spring. I proceeded to uncover my strawberry plants. I found the plants to have made a feeble start at growth, but I noticed something else coming to life—a few scattering green tender sprigs of bermuda here and there indicated too plainly that the prospect of a bermuda crop is much better than the prospect of a strawberry crop. And that is the identical spot over which we toiled during the long and weary months of last summer and fall. Under the snug and warm cover of the mulch,

the fiendish stuff had been making preparation for a final battle and complete victory to annihilate the last remnant of my once prosperous berry field. Why the Eastern, and especially the Northeastern Oklahoma farmer, should have any desire to raise bermuda grass is more than I can understand, and in this section of the state, alfalfa and clover will grow to perfection almost anywhere, and as these grasses are far superior in feeding value as well as in building up depleted soils, it would seem folly to experiment with something of doubtful value."

251. General Considerations. W. D. Bentley, who has observed bermuda grass very closely in Texas and Oklahoma, says: "The idea seems to be general that all a farmer has to do to get a permanent bermuda grass pasture is to procure the roots, scatter them on the ground and run a harrow or cultivator over them and in a short time the land will be set forever and that it will soon spread and cover the whole farm.

"Nothing is farther from the facts. The farmer in Oklahoma who gets and keeps a bermuda grass pasture must give it careful, intelligent care. For a permanent tame grass pasture, over a large section of Oklahoma, bermuda grass is the only hope and it is well worth the expense and labor necessary to get it and keep it.

"Drouth, cold and shade kill bermuda grass. The drouth and cold of the last fall and winter

almost ruined the bermuda grass in many places. In some sections of Western Oklahoma, farmers are reporting all their bermuda grass dead, but I think they will find in most places enough of it is still alive to give them another start. I have visited a large number of bermuda grass plats within the last few weeks on the light sandy lands of Western Oklahoma and find all of them badly damaged but none of them entirely killed out. I am more than ever convinced that the bermuda grass has not been given a square deal in this section. On every plat that I examined except two, the bermuda had been planted near the front door, or in the chicken or calf lot, or near the farm buildings where every living animal on the farm could get to it. The wonder of it is that any of it lived through the long drouth after such treatment.

"The best plat visited was a two-acre patch that after a good set had been secured was plowed under with a sulky turning plow to kill the weeds. The weeds were killed and the bermuda benefited.

"Those who buy bermuda roots this year may expect some dead roots among the live ones; they are there and can't be separated. However, the live roots in each sack will be worth many dollars to every farmer who takes proper care of them and gives them a fair chance."

252. Specific Questions. Location with reference to temperature and average rainfall, character of soil, the purposes for which bermuda

grass is desired, and numerous other factors enter into any consideration of the grass problem on a given farm. A few of such questions and replies are included here.

253. Afraid of it. "I wish to know if one can keep bermuda grass where he wants it or not, and if one can kill it or not. I have about six or seven acres in my farm which is very sandy and I can't raise any wheat, corn, or oats. I would like to put it to bermuda if the bermuda wouldn't scatter or keep going. I have good wheat ground all around this patch of sand."—Alfalfa county, Western Oklahoma. The only danger which will confront you with your bermuda grass is that it may freeze out in very hard winters on your sandy land. You are a little far north for it to grow vigorously and it certainly will never make any trouble for you, except that it will not spread fast enough to suit you when once you learn what this grass will do for you.

254. Varieties of Bermuda. "I am greatly interested in bermuda grass, but have a hard time getting a good start. Are there two kinds, the big and little bermuda? If so, which is the better? My subsoil is a clay. Would you advise subsoil plowing in such to get more space for moisture?"—Lincoln county, Central Oklahoma. There are two varieties of bermuda grass of equal resistance to cold; one of them growing coarse and rather erect; the other fine

and sticking closely to the soil. For general farm purposes, the coarse variety is best and the only way to get it is to observe bermuda wherever you see it growing and when a satisfactory patch is found, get a start from it. It is not worth while to subsoil for bermuda but it will be well for you to plow the land as deep as possible during the winter and plant the bermuda in April and May in rows about three feet apart, so that it may be cultivated a few times if necessary.

255. Bermuda in Sod. "Can I get a set of bermuda by setting in furrows three feet each way in a native pasture while the stock are running on it, or would it be better to plow out a little at a time and fence it off?"—Grady county, Central Oklahoma. You can get a stand of bermuda by planting it as you suggest, but it will take from two to five years to get a sod, depending upon the amount of native sod which is left and the closeness with which you pasture.

256. Starting in Pasture. "Do you think bermuda would be a success on the Plains of Lamb county, Texas Panhandle, with a 3500-foot altitude? There is some growing here in the yard at the ranch under large cottonwood trees. Could we start it in the short grass of our pastures? Please give your opinion, as I wish to read it at our farmers' meeting." There is a very good chance for you to succeed with bermuda grass when you once get it established.

You are far enough south so that the winters probably will not kill it out. It will be a rather slow job to get it established in short grass pasture, but it is worth trying. Break out narrow strips a rod apart in your pastures, disk it thoroughly and plant the bermuda roots in April or May. This work may be done easily by marking out a furrow and stringing the roots along in it, putting a small piece of the roots every foot or two in the row and covering completely.

257. Sandy Loam Pasture. "I have ten acres I want to seed to pasture in the spring. It is the highest land I have, though it's valley land and lies close up to foot of hill; light sandy loam, a good deal of sand in soil, underlaid with red clay. What kind of grass would you advise me to sow? Would it grow alfalfa?"—Hughes county, Eastern Oklahoma. The only grass which may be depended upon to succeed for pasture is bermuda. This grass is best started by planting the roots. The land should be plowed as soon as possible and worked down well. The roots may be planted at any time from March 1st to July 1st and should be dropped in rows and covered much the same as though you were planting potatoes. Alfalfa would not be expected to do well on such soil in your locality, and certainly not for pasture.

258. On Gumbo Land. "I have underbrushed and pretty well cleared ten acres of gumbo with

quite a number of dead trees still remaining. Intend to clean the brush up well and sow to pasture without first breaking. Under the above conditions which of the following grasses would you sow: Kentucky blue grass, English blue grass, red top, orchard grass, or timothy? Which is the easiest to set? Have a couple of acres of bermuda up on the prairie well set, but am afraid to try it on heavy land as above." —Tulsa county, Eastern Oklahoma. There is no grass which will do as well as bermuda on your gumbo land. English blue grass and orchard grass are next in likelihood of giving you some measure of success. Kentucky blue grass might do fairly well during the wet seasons and, unless the ground is rather moist, red top will not do very well. Bermuda grass is really at its best on gumbo soils when once established. It takes hold and covers that sort of land very quickly.

259. Upland Pasture. "I have about three or four acres of heavy timbered upland that I have cut off all but enough scattering trees to make it parklike. I wish to sow or set this in something that will make summer and winter pasture for hogs and cows. Recommend something."—McIntosh county, Eastern Oklahoma. The best grass for you to plant for permanent pasture on your upland is bermuda. This should be started by planting the roots at any time from March until July. If in the fall, after

the grass is set, you will sow seed of white clover and vetch right on the sod, it will help make winter pasture.

260. Bermuda hay is clean and excellent for feeding to horses. It contains 9.7 protein and 1.24 percent. fat; timothy hay contains 5.9 percent. protein and 2.5 percent. fat; Kentucky blue grass hay contains 7.8 percent. protein and 3.9 percent. fat. Comparative feeding trials have shown bermuda hay to be of about the same value as timothy hay for horse feed. It is probable that bermuda hay does not possess high value as feed for dairy and other cattle. A few phenomenal yields of bermuda hay are on record. At the Oklahoma Agricultural Experiment Station in 1905, a yield of 2584 pounds of cured bermuda hay per acre was obtained from two and one-half acres within three months after planting bermuda roots in rows three feet apart. But the soil was in an excellent state of cultivation and the rainfall during the three months was 14.13 inches. The following season, a total of 5.85 tons of cured bermuda hay per acre was obtained from this same field in three cuttings. But such yields as this should not be expected and this same field quickly diminished in production. Bermuda is a pasture grass and in the Central Southwest, cannot be depended upon for regular and continuous yields of hay.

261. For hog pasture, when well established

on good land, bermuda grass has no superior. In the spring of 1911, a swine breeder in Grant county, Central Oklahoma, reported that the previous season, he pastured thirteen hogs all summer on thirty square rods of bermuda grass and that they did well. That was at the rate of sixty-nine hogs to the acre, and yet he reported bermuda grass as "not satisfactory" in his locality. An extensive feeder of market hogs in Pottawatomie county, Central Oklahoma, who has one hundred acres of alfalfa on bottom land and forty acres of bermuda grass on sandy slope land not suited to alfalfa, states that an acre of his bermuda grass during a season turns off more gain in weight of hogs than he obtains from an acre of alfalfa. And further, the stand of alfalfa is damaged by pasturing with hogs, while the stand of bermuda is actually improved, the rooting of the hogs preventing it from getting sodbound. The composition of bermuda grass is such that hogs receiving no other feed have a more nearly balanced ration when pastured on bermuda grass than when pastured on alfalfa. Each spring, the bermuda hog pasture should be thoroughly disked and leveled in March.

262. Bermuda pastures become sodbound after a few years and often yield but little pasture. They may be rejuvenated by plowing with a sod plow in March and thoroughly disking. Within a few weeks, new and vigorous growth

will appear and the yields will be much improved.

263. Eradicating bermuda grass is no easy task among small fruits, but it is easily accomplished in cultivated fields. Shallow plowing during dry periods disposes of much of it. Plowing shallow in the early winter and exposing the underground stems to freezing is fatal to it in the average winter. If such land is sown to oats, to be followed with cowpeas after harvest, thus shading the ground throughout the season, eradication will be practically complete. But bermuda grass should be planted only where it is wanted permanently for pasture. It is never regarded as a pest by those who have livestock to consume it; only those who grow cotton and have no use for grass fear its spread.

264. Bermuda grass produces seed in Oklahoma. If the manure from livestock fed bermuda hay or pastured on bermuda which has matured seed heads is put on cultivated fields, small patches of the grass are almost certain to start from the seed. Such manure is thus undesirable for placing on the garden or about small fruits. But the young bermuda grass may easily be killed in the cultivated fields and the actual spreading of bermuda from this source is really very slight.

OTHER GRASSES AND CLOVERS

265. Many other grasses are sown and occasionally some of them seem to promise success, only to fail entirely when the test of the dry year comes with its great need for feed for livestock. A few of these are considered in the answers to inquiries which follow, but their being included here should not be taken to mean that any of them are to be regarded as sure feed crops.

266. Canada blue grass. "Please let me know the value of Canada blue grass as a grass for Western Oklahoma. I have some rough land that doesn't amount to much as pasture, having a bunch grass on it, inclined to be sand grass. What should I put on it for better returns?"—Texas county, Western Oklahoma. Canada blue grass is of value only in the far north, and it is not likely to do a thing in your locality. Get on hand a supply of seed of bromus inermis, and whenever you strike a period of plenty of rain, go out and scatter some of the seed over your pasture land. If you keep this up for a few years, you will be giving bromus inermis the best possible test and it is probably the only grass which may possibly improve your native pastures.

267. Timothy and Red Top. "What about timothy, red top, or red clover? What do you think of these for hay in the east side of the

state?"—LeFlore county, Eastern Oklahoma. The last few years have not been very good years for timothy, red top, and red clover even in Eastern Oklahoma. Ultimately you will place your dependence in bermuda and alfalfa, but before that time comes, the eastern counties will have to go through a period of expensive experiences with timothy and clover. On the moister lands, red top will do very well, and there will be many years in which timothy and clover will pay. Fine timothy has been grown in Ottawa county and also some excellent red top.

268. Japan Clover. "Do you think Japan clover would make a good hay crop for this part of Oklahoma? I would like very much to sow some kind of hay crop on upland that would beat alfalfa. I have been reading a good deal about Japan clover and came to the conclusion that if it would do well in Oklahoma, I would like to get some."—Custer county, Western Oklahoma. Japan clover is of absolutely no account in your part of Oklahoma. In very wet years it grows as far west as Pottawatomie county, but in years like the last two or three, western Arkansas is about the western limit of profitable growth of Japan clover. It will be a long time before you will find any hay crop that will beat alfalfa on Custer county uplands where alfalfa will grow. The last three years have, of course, been very hard on the crop, but it will rain again, and

when it rains even a little bit, your Custer county hills are just the stuff for alfalfa.

269. Sand Lucerne. "I wish to ask about sand lucerne. I have read about it and am trying to locate some one who raises it. I have been informed that it thrives and does well on very sandy soil or nearly all soils. If this forage plant is as good as I have been informed it is, it will be of great interest to very many farmers. Many parts of Oklahoma have a great deal of sand in the soil which makes it very hard to get a stand of alfalfa or to get any kind of grass crop to stay on the ground for pasture and hay land."—Kingfisher county, Central Oklahoma. Sand lucerne is very similar to alfalfa, but more spreading in its habit of growth. The seeds are somewhat smaller than alfalfa seed. At the Michigan Experiment Station, the average yield during four years was at the rate of over five tons of cured hay per acre. They obtained from three to four cuttings per season. Try it on only a small scale and sow the seed late in March or early in April at the rate of about fifteen pounds of seed per acre. The land should be prepared as for alfalfa seeding.

270. Curly Mesquite. "I send you sample of grass and would like to know what it is. It seems to be very hardy and is spreading over the prairie and setting on the hardpan spots. Some call it bermuda and some say it is not. Where it grows it kills out all the weeds and

other grass. All kinds of stock seem to like it. Could not say how tall it gets as the stock keep it eaten down."—Rogers county, Eastern Oklahoma. The sample of grass which you enclosed is curly or creeping mesquite. It is somewhat similar in appearance and habit of growth to bermuda. It is an excellent grass and, while it does not yield as much pasture as bermuda does, there is no danger of its spreading and becoming troublesome. With your heavy average rainfall, it should furnish quite a lot of pasture through the summer. This is the most promising pasture grass for the northwestern fourth of Oklahoma, where bermuda grass does not make satisfactory growth. The mesquite occupies the pastures there after the coarser grasses disappear.

271. Bromus Inermis. "Is it your impression that Bromus Inermis and English blue grass, or either, is likely to be of value for either pasture or for hay in Grant county, Oklahoma?" There is a bare possibility that bromus inermis may develop to be of some value as a pasture in Grant county, but it is a slim chance. English blue grass in favorable years might make something of a crop, but in dry years it would fail absolutely. The difficulty with bromus inermis seems to be that it gets too hot for it down here.

"I have a piece of ground I have been trying to get set to bermuda but it is so tight the bermuda doesn't seem to do any better than the

native grass. I want to know what about sowing brome grass. Is it adapted to this locality? How does it compare with the other grasses as hay and pasture? When once set, does it ever have to be replanted?"—Washita county, Central Oklahoma. It is of no value for your locality. There is nothing better than bermuda grass and you must not be discouraged, because the last two years have been very poor years for getting bermuda started.

272. Grasses for Eastern Kansas. "Cowpeas and kafircorn have done their part to bring my stock through two winters. I would like your advice about sowing grass seed in thin timber. I have a small creek bottom farm about one-third of which is now in alfalfa. There are a few acres of timber along the creek and the trees are large and very little undergrowth; the wild rye affords some early pasture. The soil is a heavy black loam, free from rocks or gravel. Will Alsike clover and timothy do well on such land. What grass would you recommend trying? The land is sometimes partly flooded by backwater, but is ordinarily well drained. I cleared some very low ground this year and intend to give bermuda a tryout if I can get hardy roots. Will bermuda stand much shade?"—Greenwood county, Kansas. In your locality you can improve the grasses in your timber land by sowing at any time in the spring a mixture of Kentucky blue grass, English blue grass, orchard grass, and white clover seed.

Just scatter the seeds about, preferably during a rain, and trust to nature to do the rest; also repeat the sowing in September. If you will keep this up for a few years, not sowing a great deal of seed at a time, but sowing a little at several times each spring and fall, you will ultimately have a fine pasture along your creek. Timothy is not a good pasture grass. It would do no harm to include a little Alsike clover in the mixture which you sow. Bermuda will not do any good in dense shade. If there are some sunny slopes facing the south in the pasture, there is the place to plant bermuda.

273. Sweet Clover. "Some two or three farmers in Grady county have asked me about the value of a forage plant called 'melilotus', and what properties it contains for feeding purposes. If there have been any experiments made with reference to this plant, I shall be very glad to have the result of these experiments. The plant very much resembles alfalfa, its growth and character being very similar but it is my understanding that it has to be replanted every two years. Any information that you can give me along the above lines will be greatly appreciated."—Grady county, Central Oklahoma. It is sweet clover that the farmers have been talking to you about. There are two species of it, scientifically designated as Melilotus alba and Melilotus officinalis. The former is also called Bokhara clover, White Melilot, and tree clover. It has white blossoms.

The other has yellow blossoms and is sometimes called Yellow clover. The variety with white blossoms is the one usually grown. It sometimes seems that the chief value of sweet clover is to start an argument. Unquestionably it furnishes excellent pasture for bees, and the nodule-forming bacteria which appear on the roots of sweet clover are probably identical with those which work on alfalfa to its great benefit. Sweet clover also possesses the ability to grow on almost any sort of soil and might be used to great advantage to build up very sandy soils and make them fertile and productive. One progressive farmer has purchased several quarter-sections of waste sandy land along the South Canadian river. He said recently that he has a few acres of sweet clover and that it furnished excellent pasture for a lot of young mules which he had on the place. He said that it was growing vigorously while the alfalfa nearby had suspended operations during the dry weather. He intends to sow quite a lot more of it and said that hay, which he made of sweet clover, before the plants began blooming was eaten readily by his stock. If hay is not made until after the plants bloom, it is coarse and strong and does not seem to be relished by animals of any sort. Those who regard sweet clover as a pasture crop say that they get the most benefit out of it very early in the spring before other things begin to grow. There is a place for extensive sowing of sweet

clover on the sandy lands along the Cimarron, South Canadian, and Red rivers. It will grow on lands where nothing else will grow profitably and should be used only in such locations. Only those who are engaged in the stock business can expect to use sweet clover to advantage. They will find that the land on which they grow it will increase in fertility and that plowing under a good crop will be of great benefit to the soil. The seed may be sown on sandy lands without previous preparation, at the rate of ten to fifteen pounds per acre followed by disking or harrowing. There is no danger whatever of its becoming a troublesome weed, although many people seem to fear it. The plant is a biennial, producing seed the second year after it is sown and if properly managed, enough seed will mature to keep the land reseeded. Waste places might profitably be sown to this crop on many farms, and if bees are kept, the honey will return a profit from land which otherwise would be unproductive.

274. Johnson Grass. It is a violation of law to sow the seed of Johnson grass or to permit it to mature seed in Oklahoma. Nearly all farmers consider this grass a pest, though some regard it as a valuable grass producing feed in very unfavorable seasons. This it unquestionably does, but the rapidity with which it spreads and its persistence in cultivated fields are very objectionable features. Johnson grass is used

largely as a hay crop in Texas, where much good land has been abandoned to the grass. It is not a satisfactory pasture grass, yielding but little after a few years of pasturing unless plowed up and given another start.

The ability of Johnson grass to withstand conditions of extreme drouth and produce feed appeals to many, as is shown by the following:

A farmer living in Ellis county, Western Oklahoma, says: "We people living in Western Oklahoma must have Johnson grass instead of bermuda and alfalfa, as they are not successful in this locality. The pasture problem is confronting us more than anything else, and I am well satisfied that if a lot of these people had Johnson grass instead of sand piles along the fences, they would reduce some of the mortgages. A four-acre patch of alfalfa, good stand, sowed a year ago last spring, has yielded about one and one-half tons of hay this season. Under the same conditions, Johnson grass would have made twenty tons."

Another who lives in the extreme western end of Cimarron county, Oklahoma, on the Plains, writes: "I have a few small patches of Johnson grass, and it is the only living vegetation in sight. I am like some others who would like to see the Johnson grass law repealed. I have observed Johnson grass for sixteen years here and don't know that it has ever hurt anyone, while I do know that it has saved the life of many a poor cow. I think it the

best and most reliable feed for this country, especially where it can be disked and harrowed each year. I also find that my best land is where Johnson grass has grown for years."

A Custer county, Western Oklahoma, stockman writes: "I want to sanction the suggestion that the Johnson grass law be repealed. That law is a crime against the stock and stock-raisers of Western Oklahoma. What if it is hard to kill out? Ten acres would be worth more than one hundred acres of any other grass for pasture or hay. It beats sunflowers and cockleburs and other weeds that are not legislated against. I would like to sow ten acres."

Another writing from Caddo county, Central Oklahoma, says: "The views of the man who likes Johnson grass suit me exactly. The Johnson grass law which we have is a mistake. The farmers of Oklahoma ought to have a right to grow what they can do best with. I have forty acres with spots of Johnson grass in it. If it had not been for the law, I could have made more money on that forty acres during the past three years than I have made from all my farm of 160 acres. The law is a farce and ought to be repealed."

Another writes from Carter county, Central Oklahoma: "I have been two years trying to get a sod of bermuda grass on twenty acres and my experience has been that the hardiest of it all has looked sick during our last dry spell and if I had to depend on it for pasture for my

milk cows, I would have been up against a high wall. The crop that saved the day when it was dry looks good to me. On land not one bit better than that where I have my bermuda, I have twenty acres of Johnson grass. That twenty acres the first of the spring pastured twenty-five head. About four weeks ago the pasture began to get short so we took out six head, leaving nineteen in there and they are doing well. The prairie hay has been too short to cut yet. My little patch of Johnson grass has been cut once and is now ready again. Now the way I am fixed is this: I have only sixty acres and sixty head of stock. My farm has to produce enough food for my stock through the winter and I want every foot to produce every bit it will. It is against the law to sow Johnson grass but don't you think it would be a good thing to try and have that law repealed?"

But the following from a farmer in Logan county, Central Oklahoma, represents the feeling of many others: "Now that those friends of Johnson grass have expressed themselves, I ask leave to submit a few reasons on the other side. I, too, speak from experience; an experience that has been costly, and the end is not yet. A neighbor of mine sowed some seed of Johnson grass. He wanted a good, sure pasture and such a mess as he has after seven or eight years of effort to add to and cut out, is enough to make a decent farmer blush for the looks of that forty. Much of his land lies along a

large creek and just across the road and down the creek I have an Indian lease of eighty acres. The overflows of the creek carry the seeds across my eighty and in defiance of my strenuous efforts to control the pest, my crops are damaged every year, and each succeeding year I have more work to do cultivating crops with less and less profit for my labor. We have that field in cotton this year and just last week with the mercury 100 in the shade, I went over the field and cut off a big sack full of seed tops, and I must keep up the cuttings until frost or have more stools next year. Now I ask in all fairness: Has a man any moral right to compel his fellowmen to undergo such labor and sustain such loss?"

The following inquiry and answer are fairly typical of conditions where Johnson grass is well distributed: "I am thinking of buying 100 acres of good land, two miles from town, one-fourth mile to good school. The land can be bought cheap, lies well, good water, but there is a big lot of Johnson grass, the great terror of this section, on it. I am thinking of buying this land for a stock farm. What do you think of it? Is Johnson grass any good, or do you know anything of it? Will it make good pasture? In case I should ever want to cultivate the land, could the Johnson grass be killed out for good? Has the Johnson grass law ever been enforced in this state? Would it interfere with the success of the farm? Or would it

pay better to buy bottom land at a big price twelve miles from town and sow alfalfa? Any light you can give will be appreciated. In case you don't know how to advise, just tell me what you would do under similar circumstances." — Stephens county, Central Oklahoma. If you want this for a stock farm, do not hesitate for a minute about buying it and going to it. Where the Johnson grass is thickest, you may make hay of it and it is ahead of timothy in feeding value. It also will furnish pasture for a time, but if heavily pastured, produces very little growth. You should take up the work of eradicating the grass systematically by fencing a portion of the farm, pasturing it heavily through the summer season, plowing shallow in November and pasturing with hogs and cattle, then later disking out some more of the underground stems so the stock can eat them. If you will follow this treatment with a crop of oats in the spring and then after oats harvest, plow the land and go over the field several times, taking out any clumps of the grass which may appear, and sow alfalfa in the fall, you will have practically cleaned out the Johnson grass. The Johnson grass law has never been fully enforced in this state and it is not likely to be. If you do not wish to grow alfalfa, the oats may be followed by wheat in the fall and then cowpeas should be planted on the wheat stubble, and by the following spring, if you work at the job of taking

out the few clumps of Johnson grass which may be left, you will have the land in first class shape for cultivation. All of the time you are doing this, you may be making good use of the rest of the Johnson grass by pasturing it and making hay off of some of it. When you make hay, the grass should be cut before the seeds have formed, as otherwise the manure will spread the grass all over the place.

ANNUAL PASTURE CROPS

275. Few annual pasture crops are certain to produce feed in seasons of extreme drouth. But the timely planting of such of these crops as are reasonably successful under average conditions may, at little expense, be made to supplement other feed crops. The use of sorghum (192), cowpeas (170), and peanuts (184) for pasture has previously been discussed.

276. Wheat and rye, sown in September or October, sometimes furnish profitable winter pasture for horses, cattle, and hogs, and often do not. Soft wheat yields more pasture than hard varieties. Where stalkfields are to be pastured during the winter, it is profitable to sow at least a portion of them to wheat or rye, for pasture alone. When wheat is to be harvested for grain, pasturing should be discontinued not later than March 1st, if a full yield is desired.

277. For early hog pasture, early sown oats is generally satisfactory. Three pounds of seed of Dwarf Essex rape to the acre may be sown with two to three bushels of oats. This should be ready to pasture in April and, after being pastured off, may be followed with sorghum, cowpeas, or peanuts, planted in rows three and one-half feet apart. Rape for early summer pasture should be drilled, about corn-planting time, in rows wide enough apart to cultivate. In very dry seasons, neither oats nor rape will provide much pasture, and sorghum (193) should be provided for late summer pasture, after rape has passed its period of profitable growth.

RAINFALL AND CROPS

By GEORGE L. BISHOP.

West of Meridian 98, in Oklahoma, means practically the main line of the Rock Island Railroad north and south, through Kingfisher, El Reno, Chickasha, Duncan, etc. West of this line we begin to approach that part of the country which is coming to be known as the dry-farming section. The term dry-farming is of recent origin, and, though it is a misnomer, the name is being accepted and understood to mean that method of farming which depends on the storing and conserving in the soil of a short or unseasonable rainfall as an insurance against drouth. Adaptation of crops and certain methods of soil culture perform very important duties in the system of dry-farming, but available moisture more than any other one thing controls the results in crop yield. This available moisture is determined first by the average rainfall of any country or locality. So the extent to which Western Oklahoma, or any part of Oklahoma, may be interested in or dependent upon dry-farming crops and cultural methods, may be ascertained by looking up its average rainfall for ten years or more. The rainfall for that section of the state lying along Meridian 98 ranges from fifteen to fifty inches, with an

average for the last thirty years of a little more than thirty inches. Some ten-year averages in certain localities run as high as thirty-four inches, and in other loaclities, along the same line, as low as twenty-eight inches.

For the four wet years of 1905-6-7-8 just preceding the last three dry years, the rainfall for Western Oklahoma was from five to fifteen inches above normal. The average for those four years was more than ten inches greater than the general average for the years which had gone before and the three which have followed immediately after.

For instance at Chickasha the average rainfall for those four years was, in whole numbers thirty-nine inches; while the average for the years before and the three which have come since, is only twenty-one inches. The ten-year average for Chickasha, not including 1911, is less than thirty inches.

Hobart, some sixty miles west of Chickasha, has an average rainfall for the four rainy seasons of thirty-eight inches. But for the years before and for the three which have just passed, the average is only twenty inches. For all the years for which we have records, there is found to be an average annual rainfall for Hobart, Kiowa county, right on Meridian 99, of twenty-seven and a half inches. For Mangum, Greer county, twenty-five miles west of Hobart, where we have records for twenty years, there is shown an average rainfall of a little more than

twenty-six inches. Here the average for the four wet years was thirty-six and a half, showing an increase of ten inches over the average for the twenty years, including the four wet ones.

If we begin farther north and go west, we find the difference and gradual decrease is maintained in about the same proportion. Ft. Reno, on Meridian 98, with records for practically thirty years, shows an average annual rainfall of about thirty inches, while Erick, in Beckham county, one hundred miles west, has an average of twenty-six, and Arapaho, Custer county, about half way between El Reno and Erick, has an average for eighteen years of twenty-eight inches. As you go north to the Kansas line the rainfall seems to be a little more regular in its habits, but with a little lower average. For instance the north tier of counties and the northwest counties have had a much nearer normal rainfall for the last three years than the southwest counties. Go on up into Kansas, and go west beginning with Manhattan for fifty years, Hays for forty years, and Dodge City for forty years, and we find an average, in whole numbers, of 31, 23, and 20 inches, respectively.

The four successive years of unusual precipitation certainly had many of us ready to accept the theory that "the rainfall follows the plow." But the three years which have followed should leave us more willing than ever to be guided

by the records in choosing the methods of culture, and kind of crops with which we are to build a permanent and profitable agriculture for Western Oklahoma.

Records for forty years at Ft. Sill, Comanche county, show that, as a rule, a year of unusual rainfall is followed by a year of short rainfall, and sometimes two short ones, and in one period five years with an average of only twenty-four inches come in succession. Then as if to prove that one extreme follows another, there followed three years with an average of forty inches. The next year was the year 1901, which many of us remember. It was the dryest for thirty years, with only sixteen inches of rain for the entire year. Then back to the other extreme, with a rainfall for 1902 of nearly forty-seven inches. Then a couple of short years before starting in with fifty inches for 1905, the first of the four wet years, which we have mentioned. Then, perhaps, to settle for all time this idea of permanent increase in rainfall, came 1910 with a little more than fourteen inches. With all these ups and downs, Ft. Sill shows an average rainfall of thirty inches for forty years.

The records show that we may expect about one-third of each year's rainfall from September to February, inclusive. That is, where the average rainfall is thirty inches, ten inches as a rule will fall in the autumn and winter months. It also shows that seven of the ten

inches usually fall in September, October, and November, the other three in December, January, and February. But there are a few sharp variations from this rule, an example of which is furnished in the rainfall of 1911, two-thirds of which came from July to December, inclusive. The records also show that very wet Decembers, such as we have had at the close of 1911, do not come often. Away back in the 70's there were four Decembers which averaged over three inches. At Ft. Sill for forty years, and at Ft. Reno for thirty years, there is shown to be only one four-inch rainfall for December. The average December rainfall is about one and a half inches, with many of them practically nothing. May, as we all know, is the most reliable month for rain, but for the forty years it shows a range of from nothing, in the year 1870, to 15.65 in 1905, with an average for the entire time of over five inches. Only four years out of the forty show less than two inches.

In examining the records for all these years, it is interesting to note how often a wet month is followed by a dry month during the growing season. This fact has a most important bearing on the methods of culture and the kind of crops necessary to make the greatest average yields. It indicates the need of stored moisture at all times, and the value of proper cultivation to conserve it. But above all, it means that the crop which may damage seriously in a day or a week by heat or lack of moisture, must be re-

placed by one which can not only stand the heat but can wait several weeks for rain if it has to, and then go on and make a profitable yield. Then, too, when we find that of all the years for which we have records in Western Oklahoma, half of the Julys show less than a two-inch rainfall, it means that nine times out of ten, for those years, the yield of corn will be greatly reduced.

Upon closer investigation the facts become all the more startling for the corn crop when the records show that for fifteen years out of the forty at Ft. Sill, and twelve years out of the thirty at Ft. Reno, the average of the combined rainfall for the months of June and July does not amount to four inches. This means that for Western Oklahoma, we may expect a little more than one year of every three to bring us a June and July in which corn, on the uplands at least, cannot hope to make a profitable yield.

The purpose of this discussion, or rather summing up, of the rainfall for Western Oklahoma, is not to explode anybody's theory nor shake the faith in any interests invested here or which may be planning to come here; and above all, it is not to make any farmer feel that his farm is worth any less today than it ever was. It is simply an honest effort to get together a few dependable facts about what we may expect to be ours in the way of rainfall for the future.

And from this we conclude:

First, that no farmer west of Meridian 98 should let any kind of preachment, previous condition of servitude, or preference as to precipitation, make him forget where "he is at".

Second, that the average rainfall of his locality should be ascertained and taken seriously; not because any possible profits of farming in such locality are determined solely by such rainfall, but because the kind of farming, and the variety of crops through which these profits may accrue, are most certainly determined by the average rainfall of that locality.

Third, that the rainfall for Western Oklahoma, though irregular and once in a great while distressingly short, is ample for profitable crop production; provided we, as far as possible, store that rainfall when it comes, plant mostly such crops as have proven themselves able to make yields on the worst years, and give more attention to the proper preparation and cultivation of the soil. Briefly stated, it would be: conservation of moisture, adaptation of crops, and scientific soil culture.

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